(54) **SIX-LENS IMAGING OBJECTIVE**

(57)   An image capturing system includes six lens elements (E1-E6) which are, in order from an object side to an image side along an optical path: a first lens element (E1), a second lens element (E2), a third lens element (E3), a fourth lens element (E4), a fifth lens element (E5) and a sixth lens element (E6). Each of the six lens elements (E1-E6) has an object-side surface facing toward the object side and an image-side surface facing toward the image side. The fourth lens element (E4) has positive refractive power, the object-side surface of the fourth lens element (E4) is concave in a paraxial region thereof, and the image-side surface of the fourth lens element (E4) is convex in a paraxial region thereof. At least one of the object-side surface and the image-side surface of at least one lens element of the image capturing system has at least one inflection point (P) in an off-axis region thereof.
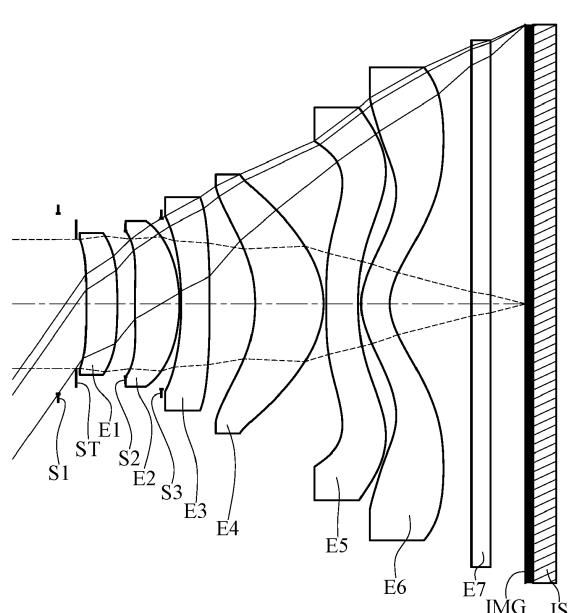
FIG. 1

Description

BACKGROUND

5   Technical Field

[0001]   The present disclosure relates to an image capturing system, an image capturing unit and an electronic device, more particularly to an image capturing system and an image capturing unit applicable to an electronic device.

10   Description of Related Art

[0002]   With the development of semiconductor manufacturing technology, the performance of image sensors has improved, and the pixel size thereof has been scaled down. Therefore, featuring high image quality becomes one of the indispensable features of an optical system nowadays.

15   **[0003]**   Furthermore, due to the rapid changes in technology, electronic devices equipped with optical systems are trending towards multi-functionality for various applications, and therefore the functionality requirements for the optical systems have been increasing. However, it is difficult for a conventional optical system to obtain a balance among the requirements such as high image quality, low sensitivity, a proper aperture size, miniaturization and a desirable field of view.

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SUMMARY

[0004]   According to one aspect of the present disclosure, an image capturing system includes six lens elements. The six lens elements are, in order from an object side to an image side along an optical path, a first lens element, a second lens element, a third lens element, a fourth lens element, a fifth lens element and a sixth lens element. Each of the six lens elements has an object-side surface facing toward the object side and an image-side surface facing toward the image side.

[0005]   The image-side surface of the second lens element is convex in a paraxial region thereof. The fourth lens element has positive refractive power, the object-side surface of the fourth lens element is concave in a paraxial region thereof, and the image-side surface of the fourth lens element is convex in a paraxial region thereof. The object-side surface of the sixth lens element is convex in a paraxial region thereof, and the image-side surface of the sixth lens element is concave in a paraxial region thereof. At least one of the object-side surface and the image-side surface of at least one lens element of the image capturing system has at least one inflection point in an off-axis region thereof.

35   **[0006]**   When an Abbe number of the fourth lens element is V4, an Abbe number of the fifth lens element is V5, a central thickness of the first lens element is CT1, a central thickness of the second lens element is CT2, a central thickness of the third lens element is CT3, a central thickness of the fourth lens element is CT4, an axial distance between the first lens element and the second lens element is T12, an axial distance between the third lens element and the fourth lens element is T34, half of a maximum field of view of the image capturing system is HFOV, and a curvature radius of the image-side surface of the second lens element is R4, the following conditions are satisfied:

40

$$1.2 < V4/V5 < 7.0;$$

45
$$3.5 < (CT1+CT2)/T12 < 9.0;$$

$$(CT3+CT4)/T34 < 6.5;$$

50
$$52.0 \text{ degrees} < HFOV < 80.0 \text{ degrees};$$

and

55

$$-7.0 < R4/CT2 < -1.6.$$

[0007]   According to one aspect of the present disclosure, an image capturing system includes six lens elements. The

six lens elements are, in order from an object side to an image side along an optical path, a first lens element, a second lens element, a third lens element, a fourth lens element, a fifth lens element and a sixth lens element. Each of the six lens elements has an object-side surface facing toward the object side and an image-side surface facing toward the image side.

[0008] The second lens element has positive refractive power, and the image-side surface of the second lens element is convex in a paraxial region thereof. The fourth lens element has positive refractive power, the object-side surface of the fourth lens element is concave in a paraxial region thereof, and the image-side surface of the fourth lens element is convex in a paraxial region thereof. The image-side surface of the sixth lens element is concave in a paraxial region thereof. At least one of the object-side surface and the image-side surface of at least one lens element of the image capturing system has at least one inflection point in an off-axis region thereof.

[0009] When an Abbe number of the fourth lens element is V4, an Abbe number of the fifth lens element is V5, a central thickness of the first lens element is CT1, a central thickness of the second lens element is CT2, a central thickness of the third lens element is CT3, a central thickness of the fourth lens element is CT4, an axial distance between the first lens element and the second lens element is T12, an axial distance between the third lens element and the fourth lens element is T34, half of a maximum field of view of the image capturing system is HFOV, a focal length of the image capturing system is f, a curvature radius of the object-side surface of the first lens element is R1, and a curvature radius of the image-side surface of the first lens element is R2, the following conditions are satisfied:

$$1.2 < V4/V5 < 7.0;$$

$$2.5 < (CT1+CT2)/T12 < 9.0;$$

$$(CT3+CT4)/T34 < 5.5;$$

$$52.0 \text{ degrees} < HFOV < 80.0 \text{ degrees};$$

and

$$|f/R1|+|f/R2| < 1.5.$$

[0010] According to one aspect of the present disclosure, an image capturing system includes six lens elements. The six lens elements are, in order from an object side to an image side along an optical path, a first lens element, a second lens element, a third lens element, a fourth lens element, a fifth lens element and a sixth lens element. Each of the six lens elements has an object-side surface facing toward the object side and an image-side surface facing toward the image side.

[0011] The second lens element has positive refractive power. The fourth lens element has positive refractive power, the object-side surface of the fourth lens element is concave in a paraxial region thereof, and the image-side surface of the fourth lens element is convex in a paraxial region thereof. The object-side surface of the sixth lens element is convex in a paraxial region thereof. At least one of the object-side surface and the image-side surface of at least one lens element of the image capturing system has at least one inflection point in an off-axis region thereof.

[0012] When an Abbe number of the fourth lens element is V4, an Abbe number of the fifth lens element is V5, a central thickness of the first lens element is CT1, a central thickness of the second lens element is CT2, a central thickness of the third lens element is CT3, a central thickness of the fourth lens element is CT4, an axial distance between the first lens element and the second lens element is T12, an axial distance between the third lens element and the fourth lens element is T34, half of a maximum field of view of the image capturing system is HFOV, a focal length of the image capturing system is f, and a curvature radius of the object-side surface of the first lens element is R1, the following conditions are satisfied:

$$1.2 < V4/V5 < 7.0;$$

$$3.5 < (CT1+CT2)/T12 < 9.0;$$

$$(CT3+CT4)/T34 < 5.0;$$

$$52.0 \text{ degrees} < HFOV < 80.0 \text{ degrees};$$

and

$$|f/R1| < 0.90.$$

[0013]   According to another aspect of the present disclosure, an image capturing unit includes one of the aforementioned image capturing systems and an image sensor, wherein the image sensor is disposed on an image surface of the image capturing system.

[0014]   According to another aspect of the present disclosure, an electronic device includes the aforementioned image capturing unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]   The disclosure can be better understood by reading the following detailed description of the embodiments, with reference made to the accompanying drawings as follows:

Fig. 1 is a schematic view of an image capturing unit according to the 1st embodiment of the present disclosure;
Fig. 2 shows spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 1st embodiment;
Fig. 3 is a schematic view of an image capturing unit according to the 2nd embodiment of the present disclosure;
Fig. 4 shows spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 2nd embodiment;
Fig. 5 is a schematic view of an image capturing unit according to the 3rd embodiment of the present disclosure;
Fig. 6 shows spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 3rd embodiment;
Fig. 7 is a schematic view of an image capturing unit according to the 4th embodiment of the present disclosure;
Fig. 8 shows spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 4th embodiment;
Fig. 9 is a schematic view of an image capturing unit according to the 5th embodiment of the present disclosure;
Fig. 10 shows spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 5th embodiment;
Fig. 11 is a schematic view of an image capturing unit according to the 6th embodiment of the present disclosure;
Fig. 12 shows spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 6th embodiment;
Fig. 13 is a schematic view of an image capturing unit according to the 7th embodiment of the present disclosure;
Fig. 14 shows spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 7th embodiment;
Fig. 15 is a schematic view of an image capturing unit according to the 8th embodiment of the present disclosure;
Fig. 16 shows spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 8th embodiment;
Fig. 17 is a perspective view of an image capturing unit according to the 9th embodiment of the present disclosure;
Fig. 18 is one perspective view of an electronic device according to the 10th embodiment of the present disclosure;
Fig. 19 is another perspective view of the electronic device in Fig. 18;
Fig. 20 is a block diagram of the electronic device in Fig. 18;
Fig. 21 is one perspective view of an electronic device according to the 11th embodiment of the present disclosure;
Fig. 22 is one perspective view of an electronic device according to the 12th embodiment of the present disclosure;
Fig. 23 shows a schematic view of YS, Y11, Yc51, Yc52, Yc61, Y62, Yc62, some inflection points and critical points of lens elements according to the 1st embodiment of the present disclosure;
Fig. 24 shows a schematic view of a configuration of one light-folding element in an image capturing system according to one embodiment of the present disclosure;
Fig. 25 shows a schematic view of another configuration of one light-folding element in an image capturing system according to one embodiment of the present disclosure; and

Fig. 26 shows a schematic view of a configuration of two light-folding elements in an image capturing system according to one embodiment of the present disclosure.

DETAILED DESCRIPTION

[0016] An image capturing system includes six lens elements. The six lens elements are, in order from an object side to an image side along an optical path, a first lens element, a second lens element, a third lens element, a fourth lens element, a fifth lens element and a sixth lens element. Each of the six lens elements of the image capturing system has an object-side surface facing toward the object side and an image-side surface facing toward the image side.

[0017] The second lens element can have positive refractive power. Therefore, it is favorable for reducing the size of the object side of the image capturing system. The image-side surface of the second lens element can be convex in a paraxial region thereof. Therefore, it is favorable for adjusting the surface shape and the refractive power of the second lens element so as to reduce the size of the object side of the image capturing system.

[0018] The fourth lens element has positive refractive power. Therefore, it is favorable for reducing the size of the image side of the image capturing system. The object-side surface of the fourth lens element is concave in a paraxial region thereof. Therefore, it is favorable for adjusting the traveling direction of light so as to reduce the outer diameter of the object side of the image capturing system. The image-side surface of the fourth lens element is convex in a paraxial region thereof. Therefore, it is favorable for adjusting the traveling direction of light so as to enlarge the image surface.

[0019] The object-side surface of the sixth lens element can be convex in a paraxial region thereof. Therefore, it is favorable for adjusting the surface shape of the sixth lens element so as to correct aberrations. The image-side surface of the sixth lens element can be concave in a paraxial region thereof. Therefore, it is favorable for adjusting the back focal length within a proper range.

[0020] According to the present disclosure, at least one of the object-side surface and the image-side surface of at least one lens element of the image capturing system has at least one inflection point in an off-axis region thereof. Therefore, it is favorable for increasing the shape variation of the lens elements so as to correct aberrations and reduce the size of the lens elements. Moreover, at least one of the object-side surface and the image-side surface of each of at least two lens elements of the image capturing system can have at least one inflection point in an off-axis region thereof. Moreover, at least one of the object-side surface and the image-side surface of each of at least three lens elements of the image capturing system can have at least one inflection point in an off-axis region thereof. Please refer to Fig. 23, which shows a schematic view of the inflection points P of the second lens element E2, the fourth lens element E4, the fifth lens element E5 and the sixth lens element E6 according to the 1st embodiment of the present disclosure. The inflection points P of the second lens element E2, the fourth lens element E4, the fifth lens element E5 and the sixth lens element E6 in Fig. 23 are only exemplary. Each of the lens elements in various embodiments of the present disclosure can have one or more inflection points.

[0021] The object-side surface of the fifth lens element can have at least one concave critical point in an off-axis region thereof. Therefore, it is favorable for adjusting the traveling direction of light so as to enlarge the image surface. The image-side surface of the fifth lens element can have at least one convex critical point in an off-axis region thereof. Therefore, it is favorable for adjusting the surface shape of the fifth lens element so as to correct off-axis aberrations, such as field curvature. Moreover, When a vertical distance between a non-axial concave critical point on the object-side surface of the fifth lens element and an optical axis is $Yc51$, and a vertical distance between a non-axial convex critical point on the image-side surface of the fifth lens element and the optical axis is $Yc52$, the object-side surface of the fifth lens element can have at least one concave critical point in an off-axis region thereof and the image-side surface of the fifth lens element can have at least one convex critical point in an off-axis region thereof satisfying the following condition: $0.70 < Yc52/Yc51 < 1.4$. Therefore, it is favorable for adjusting the surface shape of the fifth lens element so as to enlarge the field of view and improve image quality. Please refer to Fig. 23, which shows a schematic view of $Yc51$, $Yc52$ and some of the non-axial critical points C of the fifth lens element E5 according to the 1st embodiment of the present disclosure.

[0022] The object-side surface of the sixth lens element can have at least one concave critical point in an off-axis region thereof. Therefore, it is favorable for adjusting the incident direction of light on the sixth lens element so as to reduce surface reflection of light at wide field of view. The image-side surface of the sixth lens element can have at least one convex critical point in an off-axis region thereof. Therefore, it is favorable for adjusting the incident angle of light on the image surface so as to improve the response efficiency of the image sensor. Moreover, when a vertical distance between a non-axial concave critical point on the object-side surface of the sixth lens element and the optical axis is $Yc61$, and a vertical distance between a non-axial convex critical point on the image-side surface of the sixth lens element and the optical axis is $Yc62$, the object-side surface of the sixth lens element can have at least one concave critical point in an off-axis region thereof and the image-side surface of the sixth lens element can have at least one convex critical point in an off-axis region thereof satisfying the following condition: $1.0 < Yc62/Yc61 < 2.0$. Therefore, it is favorable for adjusting the surface shape of the sixth lens element so as to improve image quality on the peripheral region of the

image surface. Please refer to Fig. 23, which shows a schematic view of Yc61, Yc62 and the non-axial critical points C of the sixth lens element E6 according to the 1st embodiment of the present disclosure. The non-axial critical points C of the fifth lens element E5 and the sixth lens element E6 in Fig. 23 are only exemplary. Each of the lens elements in various embodiments of the present disclosure can have one or more non-axial critical points.

[0023] When an Abbe number of the fourth lens element is V4, and an Abbe number of the fifth lens element is V5, the following condition is satisfied: 1.2 < V4/V5 < 7.0. Therefore, it is favorable for the fourth lens element and fifth lens element to collaborate with each other so as to correct aberrations, such as chromatic aberration. Moreover, the following condition can also be satisfied: 1.7 < V4/V5 < 6.0. Moreover, the following condition can also be satisfied: 2.2 < V4/V5 < 5.5. Moreover, the following condition can also be satisfied: 2.7 < V4/V5 < 5.0.

[0024] When a central thickness of the first lens element is CT1, a central thickness of the second lens element is CT2, and an axial distance between the first lens element and the second lens element is T12, the following condition is satisfied: 2.5 < (CT1+CT2)/T12 or (CT1+CT2)/T12 < 9.0. Therefore, it is favorable for the first lens element and second lens element to collaborate with each other so as to reduce the size of the object side of the image capturing system and enlarge the field of view. Moreover, the following condition can also be satisfied: 3.0 < (CT1+CT2)/T12. Moreover, the following condition can also be satisfied: 3.5 < (CT1+CT2)/T12. Moreover, the following condition can also be satisfied: 4.0 < (CT1+CT2)/T12. Moreover, the following condition can also be satisfied: (CT1+CT2)/T12 < 8.0. Moreover, the following condition can also be satisfied: (CT1+CT2)/T12 < 7.0. Moreover, the following condition can also be satisfied: 2.5 < (CT1+CT2)/T12 < 9.0. Moreover, the following condition can also be satisfied: 3.5 < (CT1+CT2)/T12 < 9.0. Moreover, the following condition can also be satisfied: 3.0 < (CT1+CT2)/T12 < 8.0. Moreover, the following condition can also be satisfied: 4.0 < (CT1+CT2)/T12 < 7.0.

[0025] When a central thickness of the third lens element is CT3, a central thickness of the fourth lens element is CT4, and an axial distance between the third lens element and the fourth lens element is T34, the following condition is satisfied: 1.0 < (CT3+CT4)/T34 or (CT3+CT4)/T34 < 6.5. Therefore, it is favorable for the third lens element and the fourth lens element to collaborate with each other so as to balance the size distribution at the object side and the image side of the image capturing system. Moreover, the following condition can also be satisfied: 1.4 < (CT3+CT4)/T34. Moreover, the following condition can also be satisfied: 1.7 < (CT3+CT4)/T34. Moreover, the following condition can also be satisfied: 2.0 < (CT3+CT4)/T34. Moreover, the following condition can also be satisfied: (CT3+CT4)/T34 < 6.0. Moreover, the following condition can also be satisfied: (CT3+CT4)/T34 < 5.5. Moreover, the following condition can also be satisfied: (CT3+CT4)/T34 < 5.0. Moreover, the following condition can also be satisfied: (CT3+CT4)/T34 < 4.5. Moreover, the following condition can also be satisfied: (CT3+CT4)/T34 < 4.0. Moreover, the following condition can also be satisfied: 1.0 < (CT3+CT4)/T34 < 6.0. Moreover, the following condition can also be satisfied: 1.7 < (CT3+CT4)/T34 < 5.0. Moreover, the following condition can also be satisfied: 2.0 < (CT3+CT4)/T34 < 4.5.

[0026] When half of a maximum field of view of the image capturing system is HFOV, the following condition is satisfied: 52.0 degrees < HFOV < 80.0 degrees. Therefore, it is favorable for obtaining a wide angle configuration and preventing excessive distortion which causes difficult image processing. Moreover, the following condition can also be satisfied: 54.5 degrees < HFOV < 70.0 degrees.

[0027] When a curvature radius of the image-side surface of the second lens element is R4, and the central thickness of the second lens element is CT2, the following condition can be satisfied: -7.0 < R4/CT2 < -1.6. Therefore, it is favorable for adjusting the surface shape of the second lens element so as to reduce the size of the object side of the image capturing system. Moreover, the following condition can also be satisfied: -6.0 < R4/CT2 < -1.9. Moreover, the following condition can also be satisfied: -5.0 < R4/CT2 < -2.2.

[0028] When a focal length of the image capturing system is f, a curvature radius of the object-side surface of the first lens element is R1, and a curvature radius of the image-side surface of the first lens element is R2, the following condition can be satisfied: |f/R1|+|f/R2| < 1.5. Therefore, it is favorable for adjusting the surface shape and refractive power of the first lens element so as to enlarge the field of view and correct aberrations. Moreover, the following condition can also be satisfied: |f/R1|+|f/R2| < 1.2. Moreover, the following condition can also be satisfied: |f/R1|+|f/R2| < 0.90. Moreover, the following condition can also be satisfied: |f/R1|+|f/R2| < 0.70.

[0029] When the focal length of the image capturing system is f, and the curvature radius of the object-side surface of the first lens element is R1, the following condition can be satisfied: |f/R1| < 0.90. Therefore, it is favorable for adjusting the surface shape and refractive power of the first lens element so as to reduce the outer diameter of the object side of the image capturing system. Moreover, the following condition can also be satisfied: |f/R1| < 0.75. Moreover, the following condition can also be satisfied: |f/R1| < 0.60. Moreover, the following condition can also be satisfied: |f/R1| < 0.45.

[0030] When an Abbe number of the second lens element is V2, an Abbe number of the third lens element is V3, the Abbe number of the fourth lens element is V4, and the Abbe number of the fifth lens element is V5, the following condition can be satisfied: 2.8 < (V2+V4)/(V3+V5) < 6.0. Therefore, a proper material selection of the lens elements is favorable for correcting aberrations.

[0031] When an axial distance between the object-side surface of the first lens element and the image surface is TL, and a maximum image height of the image capturing system (which can be half of a diagonal length of an effective

photosensitive area of an image sensor) is ImgH, the following condition can be satisfied: 1.0 < TL/ImgH < 2.0. Therefore, it is favorable for obtaining a balance between reducing the total track length and enlarging the image surface.

[0032]   When an entrance pupil diameter of the image capturing system is EPD, and a maximum effective radius of the object-side surface of the first lens element is Y11, the following condition can be satisfied: 1.8 < EPD/Y11 < 2.2. Therefore, it is favorable for obtaining a balance between enlarging the aperture size and reducing the outer diameter of the object side of the image capturing system. Please refer to Fig. 23, which shows a schematic view of Y11 according to the 1st embodiment of the present disclosure.

[0033]   When a curvature radius of the object-side surface of the sixth lens element is R11, and a curvature radius of the image-side surface of the sixth lens element is R12, the following condition can be satisfied: 2.0 < (R11+R12)/(R11-R12). Therefore, it is favorable for adjusting the surface shape of the sixth lens element so as to correct aberrations. Moreover, the following condition can also be satisfied: 2.5 < (R11+R12)/(R11-R12) < 14.

[0034]   When the focal length of the image capturing system is f, a focal length of the fifth lens element is f5, and a focal length of the sixth lens element is f6, the following condition can be satisfied: -2.0 < f/f5+f/f6 < 0. Therefore, it is favorable for balancing the refractive power distribution at the image side of the image capturing system so as to correct aberrations. Moreover, the following condition can also be satisfied: -1.2 < f/f5+f/f6 < -0.45.

[0035]   When a curvature radius of the object-side surface of the fifth lens element is R9, a curvature radius of the image-side surface of the fifth lens element is R10, the curvature radius of the object-side surface of the sixth lens element is R11, and the curvature radius of the image-side surface of the sixth lens element is R12, the following condition can be satisfied: |R11/R9|+|R12/R10| < 0.50. Therefore, it is favorable for the fifth lens element and sixth lens element to collaborate with each other so as to correct aberrations.

[0036]   When an Abbe number of the first lens element is V1, the Abbe number of the second lens element is V2, the Abbe number of the third lens element is V3, the Abbe number of the fourth lens element is V4, the Abbe number of the fifth lens element is V5, an Abbe number of the sixth lens element is V6, an Abbe number of the i-th lens element is Vi, a refractive index of the first lens element is N1, a refractive index of the second lens element is N2, a refractive index of the third lens element is N3, a refractive index of the fourth lens element is N4, a refractive index of the fifth lens element is N5, a refractive index of the sixth lens element is N6, and a refractive index of the i-th lens element is Ni, at least one lens element of the image capturing system can satisfy the following condition: 5.0 < Vi/Ni < 11, wherein i = 1, 2, 3, 4, 5 or 6. Therefore, a proper material selection of the lens elements is favorable for reducing the size and correcting aberrations.

[0037]   When the central thickness of the fourth lens element is CT4, a central thickness of the fifth lens element is CT5, a central thickness of the sixth lens element is CT6, an axial distance between the fourth lens element and the fifth lens element is T45, and an axial distance between the fifth lens element and the sixth lens element is T56, the following condition can be satisfied: 3.3 < (CT4+CT5+CT6)/(T45+T56) < 50. Therefore, it is favorable for adjusting the distribution of lens elements at the image side of the image capturing system so as to reduce the total track length.

[0038]   When an f-number of the image capturing system is Fno, the following condition can be satisfied: 1.4 < Fno < 2.4. Therefore, it is favorable for obtaining a balance between the illuminance and the depth of field.

[0039]   When half of the maximum field of view of the image capturing system is HFOV, the maximum effective radius of the object-side surface of the first lens element is Y11, and a maximum effective radius of the image-side surface of the sixth lens element is Y62, the following condition can be satisfied: 5.0 < tan(HFOV)xY62/Y11. Therefore, it is favorable for adjusting the traveling direction of light so as to obtain a balance between the field of view and the size distribution. Moreover, the following condition can also be satisfied: 5.5 < tan(HFOV)xY62/Y11 < 15. Moreover, the following condition can also be satisfied: 6.0 < tan(HFOV)xY62/Y11 < 10. Please refer to Fig. 23, which shows a schematic view of Y11 and Y62 according to the 1st embodiment of the present disclosure.

[0040]   When a curvature radius of the object-side surface of the fourth lens element is R7, and a focal length of the fourth lens element is f4, the following condition can be satisfied: -1.3 < R7/f4 < -0.40. Therefore, it is favorable for adjusting the surface shape and the refractive power of the fourth lens element so as to reduce the size. Moreover, the following condition can also be satisfied: -1.0 < R7/f4 < -0.55.

[0041]   When the Abbe number of the fifth lens element is V5, and the Abbe number of the sixth lens element is V6, the following condition can be satisfied: 20.0 < V5+V6 < 65.0. Therefore, it is favorable for the fifth lens element and the sixth lens element to collaborate with each other so as to correct chromatic aberration. Moreover, the following condition can also be satisfied: 30.0 < V5+V6 < 60.0.

[0042]   When the maximum effective radius of the object-side surface of the first lens element is Y11, and the maximum effective radius of the image-side surface of the sixth lens element is Y62, the following condition can be satisfied: 3.4 < Y62/Y11 < 5.0. Therefore, it is favorable for adjusting the traveling direction of light so as to reduce the outer diameter of the object side of the image capturing system and enlarge the image surface.

[0043]   According to the present disclosure, the image capturing system further includes an aperture stop. When an aperture radius of the aperture stop is YS, and the maximum effective radius of the object-side surface of the first lens element is Y11, and the following condition can be satisfied: 0.90 < YS/Y11 < 1.1. Therefore, it is favorable for obtaining

a balance between enlarging the aperture size and reducing the outer diameter of the object side of the image capturing system. Please refer to Fig. 23, which shows a schematic view of YS and Y11 according to the 1st embodiment of the present disclosure.

[0044] When a focal length of the first lens element is f1, a focal length of the second lens element is f2, and a focal length of the third lens element is f3, the following condition can be satisfied: |f2/f1|+|f2/f3| < 1.0. Therefore, it is favorable for adjusting the refractive power distribution at the object side of the image capturing system so as to correct aberrations. Moreover, the following condition can also be satisfied: |f2/f1|+|f2/f3| < 0.70.

[0045] When the curvature radius of the object-side surface of the fourth lens element is R7, and a curvature radius of the image-side surface of the fourth lens element is R8, the following condition can be satisfied: 1.0 < (R7+R8)/(R7-R8) < 6.0. Therefore, it is favorable for adjusting the surface shape of the fourth lens element so as to balance the size distribution at the object side and the image side of the image capturing system. Moreover, the following condition can also be satisfied: 1.7 < (R7+R8)/(R7-R8) < 4.8. Moreover, the following condition can also be satisfied: 2.3 < (R7+R8)/(R7-R8) < 3.6.

[0046] According to the present disclosure, the aforementioned features and conditions can be utilized in numerous combinations so as to achieve corresponding effects.

[0047] According to the present disclosure, the lens elements of the image capturing system can be made of either glass or plastic material. When the lens elements are made of glass material, the refractive power distribution of the image capturing system may be more flexible, and the influence on imaging caused by external environment temperature change may be reduced. The glass lens element can either be made by grinding or molding. When the lens elements are made of plastic material, the manufacturing costs can be effectively reduced. Furthermore, surfaces of each lens element can be arranged to be spherical or aspheric. Spherical lens elements are simple in manufacture. Aspheric lens element design allows more control variables for eliminating aberrations thereof and reducing the required number of lens elements, and the total track length of the image capturing system can therefore be effectively shortened. Additionally, the aspheric surfaces may be formed by plastic injection molding or glass molding.

[0048] According to the present disclosure, when a lens surface is aspheric, it means that the lens surface has an aspheric shape throughout its optically effective area, or a portion(s) thereof.

[0049] According to the present disclosure, one or more of the lens elements' material may optionally include an additive which alters the lens elements' transmittance in a specific range of wavelength for a reduction in unwanted stray light or color deviation. For example, the additive may optionally filter out light in the wavelength range of 600 nm to 800 nm to reduce excessive red light and/or near infrared light; or may optionally filter out light in the wavelength range of 350 nm to 450 nm to reduce excessive blue light and/or near ultraviolet light from interfering the final image. The additive may be homogeneously mixed with a plastic material to be used in manufacturing a mixed-material lens element by injection molding. Moreover, the additive may be coated on the lens surfaces to provide the abovementioned effects.

[0050] According to the present disclosure, each of an object-side surface and an image-side surface has a paraxial region and an off-axis region. The paraxial region refers to the region of the surface where light rays travel close to the optical axis, and the off-axis region refers to the region of the surface away from the paraxial region. Particularly, unless otherwise stated, when the lens element has a convex surface, it indicates that the surface is convex in the paraxial region thereof; when the lens element has a concave surface, it indicates that the surface is concave in the paraxial region thereof. Moreover, when a region of refractive power or focus of a lens element is not defined, it indicates that the region of refractive power or focus of the lens element is in the paraxial region thereof.

[0051] According to the present disclosure, an inflection point is a point on the surface of the lens element at which the surface changes from concave to convex, or vice versa. A critical point is a non-axial point of the lens surface where its tangent is perpendicular to the optical axis.

[0052] According to the present disclosure, the image surface of the image capturing system, based on the corresponding image sensor, can be flat or curved, especially a curved surface being concave facing towards the object side of the image capturing system.

[0053] According to the present disclosure, an image correction unit, such as a field flattener, can be optionally disposed between the lens element closest to the image side of the image capturing system along the optical path and the image surface for correction of aberrations such as field curvature. The optical properties of the image correction unit, such as curvature, thickness, index of refraction, position and surface shape (convex or concave surface with spherical, aspheric, diffractive or Fresnel types), can be adjusted according to the design of the image capturing unit. In general, a preferable image correction unit is, for example, a thin transparent element having a concave object-side surface and a planar image-side surface, and the thin transparent element is disposed near the image surface.

[0054] According to the present disclosure, at least one light-folding element, such as a prism or a mirror, can be optionally disposed between an imaged object and the image surface on the imaging optical path, such that the image capturing system can be more flexible in space arrangement, and therefore the dimensions of an electronic device is not restricted by the total track length of the image capturing system. Specifically, please refer to Fig. 24 and Fig. 25. Fig. 24 shows a schematic view of a configuration of a light-folding element in an image capturing system according to

one embodiment of the present disclosure, and Fig. 25 shows a schematic view of another configuration of a light-folding element in an image capturing system according to one embodiment of the present disclosure. In Fig. 24 and Fig. 25, the image capturing system can have, in order from an imaged object (not shown in the figures) to an image surface IMG along an optical path, a first optical axis OA1, a light-folding element LF and a second optical axis OA2. The light-folding element LF can be disposed between the imaged object and a lens group LG of the image capturing system as shown in Fig. 24 or disposed between a lens group LG of the image capturing system and the image surface IMG as shown in Fig. 25. Furthermore, please refer to Fig. 26, which shows a schematic view of a configuration of two light-folding elements in an image capturing system according to one embodiment of the present disclosure. In Fig. 26, the image capturing system can have, in order from an imaged object (not shown in the figure) to an image surface IMG along an optical path, a first optical axis OA1, a first light-folding element LF1, a second optical axis OA2, a second light-folding element LF2 and a third optical axis OA3. The first light-folding element LF1 is disposed between the imaged object and a lens group LG of the image capturing system, the second light-folding element LF2 is disposed between the lens group LG of the image capturing system and the image surface IMG, and the travelling direction of light on the first optical axis OA1 can be the same direction as the travelling direction of light on the third optical axis OA3 as shown in Fig. 26. The image capturing system can be optionally provided with three or more light-folding elements, and the present disclosure is not limited to the type, amount and position of the light-folding elements of the embodiments disclosed in the aforementioned figures.

[0055]   According to the present disclosure, the image capturing system can include at least one stop, such as an aperture stop, a glare stop or a field stop. Said glare stop or said field stop is set for eliminating the stray light and thereby improving image quality thereof.

[0056]   According to the present disclosure, an aperture stop can be configured as a front stop or a middle stop. A front stop disposed between an imaged object and the first lens element can provide a longer distance between an exit pupil of the image capturing system and the image surface to produce a telecentric effect, and thereby improves the image-sensing efficiency of an image sensor (for example, CCD or CMOS). A middle stop disposed between the first lens element and the image surface is favorable for enlarging the viewing angle of the image capturing system and thereby provides a wider field of view for the same.

[0057]   According to the present disclosure, the image capturing system can include an aperture control unit. The aperture control unit may be a mechanical component or a light modulator, which can control the size and shape of the aperture through electricity or electrical signals. The mechanical component can include a movable member, such as a blade assembly or a light shielding sheet. The light modulator can include a shielding element, such as a filter, an electrochromic material or a liquid-crystal layer. The aperture control unit controls the amount of incident light or exposure time to enhance the capability of image quality adjustment. In addition, the aperture control unit can be the aperture stop of the present disclosure, which changes the f-number to obtain different image effects, such as the depth of field or lens speed.

[0058]   According to the above description of the present disclosure, the following specific embodiments are provided for further explanation.

1st Embodiment

[0059]   Fig. 1 is a schematic view of an image capturing unit according to the 1st embodiment of the present disclosure. Fig. 2 shows, in order from left to right, spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 1st embodiment. In Fig. 1, the image capturing unit 1 includes the image capturing system (its reference numeral is omitted) of the present disclosure and an image sensor IS. The image capturing system includes, in order from an object side to an image side along an optical axis, a stop S1, an aperture stop ST, a first lens element E1, a stop S2, a second lens element E2, a stop S3, a third lens element E3, a fourth lens element E4, a fifth lens element E5, a sixth lens element E6, a filter E7 and an image surface IMG. The image capturing system includes six lens elements (E1, E2, E3, E4, E5 and E6) with no additional lens element disposed between each of the adjacent six lens elements.

[0060]   The first lens element E1 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The first lens element E1 is made of plastic material and has the object-side surface and the image-side surface being both aspheric.

[0061]   The second lens element E2 with positive refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The second lens element E2 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the second lens element E2 has one inflection point.

[0062]   The third lens element E3 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being planar in a paraxial region thereof. The third lens element E3 is made of plastic material and has the object-side surface and the image-side surface being both aspheric.

[0063] The fourth lens element E4 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fourth lens element E4 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fourth lens element E4 has one inflection point. The image-side surface of the fourth lens element E4 has one inflection point.

[0064] The fifth lens element E5 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The fifth lens element E5 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fifth lens element E5 has three inflection points. The image-side surface of the fifth lens element E5 has two inflection points. The object-side surface of the fifth lens element E5 has one concave critical point in an off-axis region thereof. The image-side surface of the fifth lens element E5 has one convex critical point in an off-axis region thereof.

[0065] The sixth lens element E6 with positive refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The sixth lens element E6 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the sixth lens element E6 has two inflection points. The image-side surface of the sixth lens element E6 has one inflection point. The object-side surface of the sixth lens element E6 has one concave critical point in an off-axis region thereof. The image-side surface of the sixth lens element E6 has one convex critical point in an off-axis region thereof.

[0066] The filter E7 is made of glass material and located between the sixth lens element E6 and the image surface IMG, and will not affect the focal length of the image capturing system. The image sensor IS is disposed on or near the image surface IMG of the image capturing system.

[0067] The equation of the aspheric surface profiles of the aforementioned lens elements of the 1st embodiment is expressed as follows:

$$X(Y) = (Y^2/R)/\left(1 + sqrt\left(1 - (1+k) \times (Y/R)^2\right)\right) + \sum_i (Ai) \times (Y^i)$$

, where,

X is the displacement in parallel with the optical axis from an axial vertex on the aspheric surface to a point at a distance of Y from the optical axis on the aspheric surface;
Y is the vertical distance from the point on the aspheric surface to the optical axis;
R is the curvature radius;
k is the conic coefficient; and
Ai is the i-th aspheric coefficient, and in the embodiments, i may be, but is not limited to, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30.

[0068] In the image capturing system of the image capturing unit according to the 1st embodiment, when a focal length of the image capturing system is f, an f-number of the image capturing system is Fno, and half of a maximum field of view of the image capturing system is HFOV, these parameters have the following values: f = 2.80 millimeters (mm), Fno = 1.98, and HFOV = 55.1 degrees (deg.).

[0069] When an Abbe number of the second lens element E2 is V2, an Abbe number of the third lens element E3 is V3, an Abbe number of the fourth lens element E4 is V4, and an Abbe number of the fifth lens element E5 is V5, the following condition is satisfied: (V2+V4)/(V3+V5) = 2.96.

[0070] When the Abbe number of the fourth lens element E4 is V4, and the Abbe number of the fifth lens element E5 is V5, the following condition is satisfied: V4/V5 = 2.88.

[0071] When the Abbe number of the fifth lens element E5 is V5, and an Abbe number of the sixth lens element E6 is V6, the following condition is satisfied: V5+V6 = 56.9.

[0072] When an Abbe number of the first lens element E1 is V1, and a refractive index of the first lens element E1 is N1, the following condition is satisfied: V1/N1 = 36.30.

[0073] When the Abbe number of the second lens element E2 is V2, and a refractive index of the second lens element E2 is N2, the following condition is satisfied: V2/N2 = 36.26.

[0074] When the Abbe number of the third lens element E3 is V3, and a refractive index of the third lens element E3 is N3, the following condition is satisfied: V3/N3 = 10.90.

[0075] When the Abbe number of the fourth lens element E4 is V4, and a refractive index of the fourth lens element E4 is N4, the following condition is satisfied: V4/N4 = 36.26.

[0076] When the Abbe number of the fifth lens element E5 is V5, and a refractive index of the fifth lens element E5 is

N5, the following condition is satisfied: V5/N5 = 11.65.

[0077] When the Abbe number of the sixth lens element E6 is V6, and a refractive index of the sixth lens element E6 is N6, the following condition is satisfied: V6/N6 = 23.91.

[0078] When a central thickness of the first lens element E1 is CT1, a central thickness of the second lens element E2 is CT2, and an axial distance between the first lens element E1 and the second lens element E2 is T12, the following condition is satisfied: (CT1+CT2)/T12 = 4.26. In this embodiment, an axial distance between two adjacent lens elements is a distance in a paraxial region between two adjacent lens surfaces of the two adjacent lens elements.

[0079] When a central thickness of the third lens element E3 is CT3, a central thickness of the fourth lens element E4 is CT4, and an axial distance between the third lens element E3 and the fourth lens element E4 is T34, the following condition is satisfied: (CT3+CT4)/T34 = 2.12.

[0080] When the central thickness of the fourth lens element E4 is CT4, a central thickness of the fifth lens element E5 is CT5, a central thickness of the sixth lens element E6 is CT6, an axial distance between the fourth lens element E4 and the fifth lens element E5 is T45, and an axial distance between the fifth lens element E5 and the sixth lens element E6 is T56, the following condition is satisfied: (CT4+CT5+CT6)/(T45+T56) = 22.90.

[0081] When an axial distance between the object-side surface of the first lens element E1 and the image surface IMG is TL, and a maximum image height of the image capturing system is ImgH, the following condition is satisfied: TL/ImgH = 1.57.

[0082] When a curvature radius of the object-side surface of the fourth lens element E4 is R7, and a curvature radius of the image-side surface of the fourth lens element E4 is R8, the following condition is satisfied: (R7+R8)/(R7-R8) = 3.34.

[0083] When a curvature radius of the object-side surface of the sixth lens element E6 is R11, and a curvature radius of the image-side surface of the sixth lens element E6 is R12, the following condition is satisfied: (R11+R12)/(R11-R12) = 11.20.

[0084] When a curvature radius of the object-side surface of the fifth lens element E5 is R9, a curvature radius of the image-side surface of the fifth lens element E5 is R10, the curvature radius of the object-side surface of the sixth lens element E6 is R11, and the curvature radius of the image-side surface of the sixth lens element E6 is R12, the following condition is satisfied: |R11/R9|+|R12/R10| = 0.21.

[0085] When a curvature radius of the image-side surface of the second lens element E2 is R4, and the central thickness of the second lens element E2 is CT2, the following condition is satisfied: R4/CT2 = -3.29.

[0086] When the curvature radius of the object-side surface of the fourth lens element E4 is R7, and a focal length of the fourth lens element E4 is f4, the following condition is satisfied: R7/f4 = -0.62.

[0087] When the focal length of the image capturing system is f, and a curvature radius of the object-side surface of the first lens element E1 is R1, the following condition is satisfied: |f/R1| = 0.15.

[0088] When the focal length of the image capturing system is f, the curvature radius of the object-side surface of the first lens element E1 is R1, and a curvature radius of the image-side surface of the first lens element E1 is R2, the following condition is satisfied: |f/R1|+|f/R2| = 0.56.

[0089] When a focal length of the first lens element E1 is f1, a focal length of the second lens element E2 is f2, and a focal length of the third lens element E3 is f3, the following condition is satisfied: |f2/f1|+|f2/f3| = 0.62.

[0090] When the focal length of the image capturing system is f, a focal length of the fifth lens element E5 is f5, and a focal length of the sixth lens element E6 is f6, the following condition is satisfied: f/f5+f/f6 = -0.68.

[0091] When an entrance pupil diameter of the image capturing system is EPD, and a maximum effective radius of the object-side surface of the first lens element E1 is Y11, the following condition is satisfied: EPD/Y11 = 1.99.

[0092] When half of the maximum field of view of the image capturing system is HFOV, the maximum effective radius of the object-side surface of the first lens element E1 is Y11, and a maximum effective radius of the image-side surface of the sixth lens element E6 is Y62, the following condition is satisfied: tan(HFOV)xY62/Y11 = 5.22.

[0093] When the maximum effective radius of the object-side surface of the first lens element E1 is Y11, and the maximum effective radius of the image-side surface of the sixth lens element E6 is Y62, the following condition is satisfied: Y62/Y11 = 3.64.

[0094] When an aperture radius of the aperture stop ST is YS, and the maximum effective radius of the object-side surface of the first lens element E1 is Y11, the following condition is satisfied: YS/Y11 = 0.99.

[0095] When a vertical distance between the concave critical point on the object-side surface of the fifth lens element E5 and the optical axis is Yc51, and a vertical distance between the convex critical point on the image-side surface of the fifth lens element E5 and the optical axis is Yc52, the following condition is satisfied: Yc52/Yc51 = 1.09.

[0096] When a vertical distance between the concave critical point on the object-side surface of the sixth lens element E6 and the optical axis is Yc61, and a vertical distance between the convex critical point on the image-side surface of the sixth lens element E6 and the optical axis is Yc62, the following condition is satisfied: Yc62/Yc61 = 1.47.

[0097] The detailed optical data of the 1st embodiment are shown in Table 1 and the aspheric surface data are shown in Table 2 below.

TABLE 1							
1st Embodiment							
f = 2.80 mm, Fno = 1.98, HFOV = 55.1 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal Length
0	Object	Plano	350.000				
1	Stop	Plano		0.200			
2	Ape. Stop	Plano		0.111			
3	Lens 1	-18.2249	(ASP)	0.342	Plastic	1.545	56.1	20.58
4		-6.9895	(ASP)	0.090			
5	Stop	Plano		0.105			
6	Lens 2	8.3762	(ASP)	0.489	Plastic	1.544	56.0	2.53
7		-1.6112	(ASP)	-0.200			
8	Stop	Plano		0.220			
9	Lens 3	-3.4567	(ASP)	0.309	Plastic	1.686	18.4	-5.04
10		∞(infinity)	(ASP)	0.502			
11	Lens 4	-1.7236	(ASP)	0.754	Plastic	1.544	56.0	2.78
12		-0.9295	(ASP)	0.030			
13	Lens 5	-195.3125	(ASP)	0.351	Plastic	1.669	19.5	-4.04
14		2.7450	(ASP)	0.032			
15	Lens 6	0.6697	(ASP)	0.315	Plastic	1.566	37.4	163.62
16		0.5599	(ASP)	0.900			
17	Filter	Plano		0.210	Glass	1.517	64.2	-
18		Plano		0.384			
19	Image	Plano		-			
Note: Reference wavelength is 587.6 nm (d-line).							
An effective radius of the stop S1 (Surface 1) is 0.992 mm.							
An effective radius of the stop S2 (Surface 5) is 0.802 mm.							
An effective radius of the stop S3 (Surface 8) is 0.941 mm.							

TABLE 2				
Aspheric Coefficients				
Surface #	3	4	6	7
k =	0.00000E+00	-4.65781E+01	0.00000E+00	-5.48983E+00
A4 =	-1.82553825E-01	-3.44739789E-01	-2.33980239E-01	-3.92119615E-02
A6 =	3.33178571E-03	-4.33258643E-02	-3.52436885E-01	-8.15529336E-01
A8 =	-2.69914967E-01	2.91694386E-01	7.05527460E-01	1.94355793E+00
A10 =	5.20143712E-01	-2.46799174E-01	-1.41190250E+00	-2.67721133E+00
A12 =	-4.59118080E-01	-1.15926152E-02	2.65882413E+00	2.00816520E+00

(continued)

TABLE 2				
Aspheric Coefficients				
Surface #	3	4	6	7
A14 =	-8.60691368E-03	-	-2.67983760E+00	-7.26307366E-01
A16 =	-	-	5.83390532E-01	-
Surface #	9	10	11	12
k =	-2.40038E+01	0.00000E+00	-9.99686E-01	-2.21665E+00
A4 =	-9.56100037E-02	-1.91155788E-01	-2.09623367E-01	-6.18788324E-02
A6 =	-1.86424179E-01	3.74960119E-01	3.13187584E-01	-5.03895896E-02
A8 =	1.08636733E+00	-3.98104965E-01	-1.32978740E-01	1.08794588E-01
A10 =	-2.22373457E+00	1.98289051E-01	-3.59780867E-02	-1.11929510E-01
A12 =	2.40442187E+00	-3.93877599E-02	6.05263818E-02	7.36376295E-02
A14 =	-1.62385796E+00	-1.59695502E-03	-2.23180116E-02	-3.12333098E-02
A16 =	6.68290763E-01	1.00581349E-03	2.90652494E-03	7.45457206E-03
A18 =	-1.20174205E-01	-	-	-6.15273563E-04
Surface #	13	14	15	16
k =	0.00000E+00	-1.46877E+01	-3.11906E+00	-2.31329E+00
A4 =	4.69567904E-01	1.56881978E-01	-6.45556070E-02	-1.88596816E-01
A6 =	-1.06143152E+00	-6.49647970E-02	-8.65605234E-02	1.44310754E-01
A8 =	2.21750296E+00	-9.17958575E-02	1.50179646E-01	-9.68789236E-02
A10 =	-3.88256367E+00	1.23620703E-01	-1.40137548E-01	4.40004406E-02
A12 =	5.15557964E+00	-7.54622903E-02	7.52207854E-02	-1.26498282E-02
A14 =	-5.12464507E+00	2.77391238E-02	-2.39634658E-02	2.29184772E-03
A16 =	3.82165868E+00	-6.38785159E-03	4.63832483E-03	-2.56685638E-04
A18 =	-2.13720895E+00	8.98040393E-04	-5.37354032E-04	1.66422775E-05
A20 =	8.89547144E-01	-7.02543856E-05	3.43477900E-05	-5.28359532E-07
A22 =	-2.70863666E-01	2.33721308E-06	-9.33504313E-07	4.79176476E-09
A24 =	5.84691093E-02	-	-	-
A26 =	-8.45710726E-03	-	-	-
A28 =	7.33992888E-04	-	-	-
A30 =	-2.88640229E-05	-	-	-

[0098]   In Table 1, the curvature radius, the thickness and the focal length are shown in millimeters (mm). Surface numbers 0-19 represent the surfaces sequentially arranged from the object side to the image side along the optical axis. In Table 2, k represents the conic coefficient of the equation of the aspheric surface profiles. A4-A30 represent the aspheric coefficients ranging from the 4th order to the 30th order. The tables presented below for each embodiment are the corresponding schematic parameter and aberration curves, and the definitions of the tables are the same as Table 1 and Table 2 of the 1st embodiment. Therefore, an explanation in this regard will not be provided again.

2nd Embodiment

[0099]   Fig. 3 is a schematic view of an image capturing unit according to the 2nd embodiment of the present disclosure.

Fig. 4 shows, in order from left to right, spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 2nd embodiment. In Fig. 3, the image capturing unit 2 includes the image capturing system (its reference numeral is omitted) of the present disclosure and an image sensor IS. The image capturing system includes, in order from an object side to an image side along an optical axis, a stop S1, an aperture stop ST, a first lens element E1, a stop S2, a second lens element E2, a stop S3, a third lens element E3, a fourth lens element E4, a fifth lens element E5, a sixth lens element E6, a filter E7 and an image surface IMG. The image capturing system includes six lens elements (E1, E2, E3, E4, E5 and E6) with no additional lens element disposed between each of the adjacent six lens elements.

[0100]   The first lens element E1 with positive refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The first lens element E1 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the first lens element E1 has one inflection point.

[0101]   The second lens element E2 with positive refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The second lens element E2 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the second lens element E2 has one inflection point.

[0102]   The third lens element E3 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The third lens element E3 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The image-side surface of the third lens element E3 has two inflection points.

[0103]   The fourth lens element E4 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fourth lens element E4 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fourth lens element E4 has one inflection point. The image-side surface of the fourth lens element E4 has one inflection point.

[0104]   The fifth lens element E5 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fifth lens element E5 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fifth lens element E5 has two inflection points. The image-side surface of the fifth lens element E5 has two inflection points. The object-side surface of the fifth lens element E5 has one concave critical point in an off-axis region thereof. The image-side surface of the fifth lens element E5 has one convex critical point in an off-axis region thereof.

[0105]   The sixth lens element E6 with negative refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The sixth lens element E6 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the sixth lens element E6 has two inflection points. The image-side surface of the sixth lens element E6 has two inflection points. The object-side surface of the sixth lens element E6 has one concave critical point in an off-axis region thereof. The image-side surface of the sixth lens element E6 has one convex critical point in an off-axis region thereof.

[0106]   The filter E7 is made of glass material and located between the sixth lens element E6 and the image surface IMG, and will not affect the focal length of the image capturing system. The image sensor IS is disposed on or near the image surface IMG of the image capturing system.

[0107]   The detailed optical data of the 2nd embodiment are shown in Table 3 and the aspheric surface data are shown in Table 4 below.

TABLE 3							
2nd Embodiment							
f = 2.47 mm, Fno = 1.92, HFOV = 57.7 deg.							
Surface #		Curvature Radius		Thickness	Material	Index	Abbe #	Focal Length
0	Object	Plano		500.000				
1	Stop	Plano		0.150				
2	Ape. Stop	Plano		0.061				
3	Lens 1	8.0622	(ASP)	0.398	Plastic	1.545	56.1	9.63
4		-14.7703	(ASP)	0.044				

(continued)

TABLE 3								
2nd Embodiment								
f = 2.47 mm, Fno = 1.92, HFOV = 57.7 deg.								
Surface #		Curvature Radius		Thickness	Material	Index	Abbe #	Focal Length
5	Stop	Plano		0.107				
6	Lens 2	19.7149	(ASP)	0.574	Plastic	1.544	56.0	4.51
7		-2.7760	(ASP)	-0.214				
8	Stop	Plano		0.293				
9	Lens 3	-51.2390	(ASP)	0.300	Plastic	1.680	18.2	84.87
10		-27.2071	(ASP)	0.258				
11	Lens 4	-1.3594	(ASP)	0.648	Plastic	1.544	56.0	2.07
12		-0.7199	(ASP)	0.020				
13	Lens 5	-2.2030	(ASP)	0.285	Plastic	1.669	19.5	-4.72
14		-7.6699	(ASP)	0.049				
15	Lens 6	0.7744	(ASP)	0.369	Plastic	1.534	56.0	-5.56
16		0.5124	(ASP)	0.850				
17	Filter	Plano		0.110	Glass	1.517	64.2	-
18		Plano		0.216				
19	Image	Plano		-				
Note: Reference wavelength is 587.6 nm (d-line).								
An effective radius of the stop S1 (Surface 1) is 0.874 mm.								
An effective radius of the stop S2 (Surface 5) is 0.714 mm.								
An effective radius of the stop S3 (Surface 8) is 0.906 mm.								

TABLE 4				
Aspheric Coefficients				
Surface #	3	4	6	7
k =	0.00000E+00	-9.90000E+01	0.00000E+00	1.59806E+00
A4 =	-1.48422672E-01	-3.09041907E-01	-3.01977185E-01	-2.05802701E-01
A6 =	9.97776878E-02	-1.13039830E-01	-1.78248361E-02	-1.43608347E+00
A8 =	-8.62301941E-01	-1.07237817E-02	-1.81401594E+00	4.39920837E+00
A10 =	1.70830738E+00	5.17994276E-01	6.86926545E+00	-6.00885953E+00
A12 =	-9.45433877E-01	-8.65718323E-01	-1.49765519E+01	3.92787395E+00
A14 =	-1.26590771E+00	-	1.81233575E+01	-1.08667060E+00
A16 =	-	-	-1.10067597E+01	-
Surface #	9	10	11	12
k =	9.90000E+01	0.00000E+00	-2.48548E+00	-2.95634E+00
A4 =	-4.28532570E-02	2.12044763E-01	1.11326220E-02	-3.87994721E-01

(continued)

Surface #	9	10	11	12
A6 =	-1.86015219E+00	-1.45072374E+00	-7.41729595E-01	6.52705023E-01
A8 =	3.49289992E+00	2.64774450E+00	1.54457327E+00	-1.18243468E+00
A10 =	-2.42339537E-01	-2.57807843E+00	-1.29271782E+00	1.65478807E+00
A12 =	-6.32444342E+00	1.43487890E+00	5.56779129E-01	-1.39978873E+00
A14 =	7.80424818E+00	-4.30959071E-01	-1.22589993E-01	6.76875321E-01
A16 =	-3.72924885E+00	5.34659326E-02	1.08228337E-02	-1.69743426E-01
A18 =	6.36605482E-01	-	-	1.69131023E-02
Surface #	13	14	15	16
k =	0.00000E+00	2.24011E-01	-4.99007E+00	-2.99401E+00
A4 =	6.04708569E-01	3.81931246E-01	1.56020660E-01	-2.75789386E-02
A6 =	-1.20543825E+00	-3.06485580E-01	-3.39429608E-01	-8.06749053E-03
A8 =	3.28013083E+00	6.38178497E-02	3.23662088E-01	-1.03896485E-02
A10 =	-7.43569543E+00	6.02995185E-02	-2.19876261E-01	1.40411284E-02
A12 =	1.18927109E+01	-5.81061183E-02	9.71223336E-02	-7.03582188E-03
A14 =	-1.35531444E+01	2.45121345E-02	-2.70887624E-02	1.98537795E-03
A16 =	1.12143399E+01	-6.04091146E-03	4.76374799E-03	-3.42322286E-04
A18 =	-6.79046561E+00	8.91031257E-04	-5.14856611E-04	3.56416198E-05
A20 =	2.99821600E+00	-7.26925667E-05	3.13392391E-05	-2.04813556E-06
A22 =	-9.50508524E-01	2.51326799E-06	-8.24313640E-07	4.95952816E-08
A24 =	2.09762806E-01	-	-	-
A26 =	-3.04505608E-02	-	-	-
A28 =	2.60214750E-03	-	-	-
A30 =	-9.87768804E-05	-	-	-

[0108]   In the 2nd embodiment, the equation of the aspheric surface profiles of the aforementioned lens elements is the same as the equation of the 1st embodiment. Also, the definitions of these parameters shown in the following table are the same as those stated in the 1st embodiment with corresponding values for the 2nd embodiment, so an explanation in this regard will not be provided again.

[0109]   Moreover, these parameters can be calculated from Table 3 and Table 4 as the following values and satisfy the following conditions:

2nd Embodiment			
f [mm]	2.47	(R7+R8)/(R7-R8)	3.25
Fno	1.92	(R11+R12)/(R11-R12)	4.91
HFOV [deg.]	57.7	|R11/R9|+|R12/R10|	0.42
(V2+V4)/(V3+V5)	2.98	R4/CT2	-4.84
V4/V5	2.88	R7/f4	-0.66
V5+V6	75.4	|f/R1|	0.31
V1/N1	36.30	|f/R1|+|f/R2|	0.47
V2/N2	36.26	|f2/f1|+|f2/f3|	0.52

(continued)

2nd Embodiment			
V3/N3	10.81	f/f5+f/f6	-0.97
V4/N4	36.26	EPD/Y11	1.98
V5/N5	11.65	tan(HFOV)xY62/Y11	6.17
V6/N6	36.48	Y62/Y11	3.91
(CT1+CT2)/T12	6.44	YS/Y11	0.99
(CT3+CT4)/T34	3.67	Yc52/Yc51	1.22
(CT4+CT5+CT6)/(T45+T56)	18.87	Yc62/Yc61	1.43
TL/ImgH	1.40	-	-

3rd Embodiment

[0110] Fig. 5 is a schematic view of an image capturing unit according to the 3rd embodiment of the present disclosure. Fig. 6 shows, in order from left to right, spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 3rd embodiment. In Fig. 5, the image capturing unit 3 includes the image capturing system (its reference numeral is omitted) of the present disclosure and an image sensor IS. The image capturing system includes, in order from an object side to an image side along an optical axis, a stop S1, an aperture stop ST, a first lens element E1, a stop S2, a second lens element E2, a stop S3, a third lens element E3, a fourth lens element E4, a fifth lens element E5, a sixth lens element E6, a filter E7 and an image surface IMG. The image capturing system includes six lens elements (E1, E2, E3, E4, E5 and E6) with no additional lens element disposed between each of the adjacent six lens elements.

[0111] The first lens element E1 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The first lens element E1 is made of plastic material and has the object-side surface and the image-side surface being both aspheric.

[0112] The second lens element E2 with positive refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The second lens element E2 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the second lens element E2 has one inflection point.

[0113] The third lens element E3 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The third lens element E3 is made of plastic material and has the object-side surface and the image-side surface being both aspheric.

[0114] The fourth lens element E4 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fourth lens element E4 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fourth lens element E4 has one inflection point. The image-side surface of the fourth lens element E4 has one inflection point.

[0115] The fifth lens element E5 with negative refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The fifth lens element E5 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fifth lens element E5 has one inflection point. The image-side surface of the fifth lens element E5 has two inflection points. The object-side surface of the fifth lens element E5 has one concave critical point in an off-axis region thereof. The image-side surface of the fifth lens element E5 has one convex critical point in an off-axis region thereof.

[0116] The sixth lens element E6 with negative refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The sixth lens element E6 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the sixth lens element E6 has four inflection points. The image-side surface of the sixth lens element E6 has one inflection point. The object-side surface of the sixth lens element E6 has one concave critical point in an off-axis region thereof. The image-side surface of the sixth lens element E6 has one convex critical point in an off-axis region thereof.

[0117] The filter E7 is made of glass material and located between the sixth lens element E6 and the image surface IMG, and will not affect the focal length of the image capturing system. The image sensor IS is disposed on or near the image surface IMG of the image capturing system.

[0118] The detailed optical data of the 3rd embodiment are shown in Table 5 and the aspheric surface data are shown in Table 6 below.

TABLE 5							
3rd Embodiment							
f = 2.64 mm, Fno = 2.00, HFOV = 59.9 deg.							
Surface #		Curvature Radius		Thickness	Material	Index	Abbe #	Focal Length
0	Object	Plano		400.000				
1	Stop	Plano		0.108				
2	Ape. Stop	Plano		0.075				
3	Lens 1	-11.3025	(ASP)	0.255	Plastic	1.545	56.1	69.73
4		-8.7806	(ASP)	0.038				
5	Stop	Plano		0.096				
6	Lens 2	12.4059	(ASP)	0.549	Plastic	1.544	56.0	2.18
7		-1.2924	(ASP)	-0.200				
8	Stop	Plano		0.230				
9	Lens 3	-2.4524	(ASP)	0.264	Plastic	1.669	19.5	-4.33
10		-16.7742	(ASP)	0.405				
11	Lens 4	-1.8735	(ASP)	0.853	Plastic	1.544	56.0	2.93
12		-0.9987	(ASP)	0.030				
13	Lens 5	12.4682	(ASP)	0.318	Plastic	1.686	18.4	-6.39
14		3.2084	(ASP)	0.032				
15	Lens 6	0.6879	(ASP)	0.300	Plastic	1.566	37.4	-18.84
16		0.5444	(ASP)	0.900				
17	Filter	Plano		0.210	Glass	1.517	64.2	-
18		Plano		0.428				
19	Image	Plano		-				
Note: Reference wavelength is 587.6 nm (d-line).								
An effective radius of the stop S1 (Surface 1) is 0.773 mm.								
An effective radius of the stop S2 (Surface 5) is 0.727 mm.								
An effective radius of the stop S3 (Surface 8) is 0.893 mm.								

TABLE 6				
Aspheric Coefficients				
Surface #	3	4	6	7
k =	0.00000E+00	-1.00000E+00	0.00000E+00	-3.83782E+00
A4 =	-1.90453699E-01	-3.61820482E-01	-2.93356367E-01	-7.85754881E-02
A6 =	5.27068013E-03	3.10347246E-02	-2.54799002E-01	-9.64504020E-01
A8 =	-7.29127397E-02	-6.15789419E-02	2.04942487E-01	2.81807711E+00
A10 =	-5.11672119E-01	6.26100716E-01	2.67192763E-02	-4.78852684E+00

(continued)

TABLE 6				
Aspheric Coefficients				
Surface #	3	4	6	7
A12 =	1.89031887E+00	-9.00273835E-01	-1.26708955E+00	4.36958132E+00
A14 =	-2.13689409E+00	-	3.92537107E+00	-1.83668758E+00
A16 =	-	-	-5.09181512E+00	-
Surface #	9	10	11	12
k =	-2.68290E+01	0.00000E+00	-1.00202E+00	-1.99888E+00
A4 =	-2.26677881E-01	-1.93089924E-01	-1.89581698E-01	-9.12043864E-02
A6 =	-1.33056705E-01	2.90887132E-01	2.28218966E-01	9.25386627E-02
A8 =	1.59587200E+00	-1.61523565E-01	-7.34260410E-02	-2.13018422E-01
A10 =	-3.82716695E+00	-8.04774915E-02	1.47070278E-02	2.80118123E-01
A12 =	4.93749000E+00	1.37299609E-01	-9.81998403E-03	-2.06524661E-01
A14 =	-4.01474311E+00	-6.30771707E-02	3.73211291E-03	8.56616963E-02
A16 =	1.90676773E+00	9.71535425E-03	-4.39166846E-04	-1.80956267E-02
A18 =	-3.81276849E-01	-	-	1.49466772E-03
Surface #	13	14	15	16
k =	0.00000E+00	-6.65054E+00	-2.40600E+00	-2.23713E+00
A4 =	3.46846946E-01	3.04074127E-01	-1.38422594E-01	-1.72503750E-01
A6 =	-4.41844792E-01	-3.99753808E-01	4.14791824E-02	1.19494473E-01
A8 =	2.50374920E-01	2.91335499E-01	-6.97940190E-03	-7.96567781E-02
A10 =	1.65453964E-01	-1.45993465E-01	-1.42681158E-02	3.80390745E-02
A12 =	-6.03714612E-01	5.00285999E-02	1.30302278E-02	-1.18205569E-02
A14 =	7.74652773E-01	-1.15141066E-02	-4.85302023E-03	2.37693760E-03
A16 =	-6.17618675E-01	1.72978498E-03	9.71267217E-04	-3.06571816E-04
A18 =	3.35296180E-01	-1.60489649E-04	-1.09718348E-04	2.43727646E-05
A20 =	-1.26962869E-01	8.21109562E-06	6.60610990E-06	-1.08167396E-06
A22 =	3.34614432E-02	-1.73597990E-07	-1.65125651E-07	2.04060165E-08
A24 =	-6.00155156E-03	-	-	-
A26 =	6.96762902E-04	-	-	-
A28 =	-4.71132767E-05	-	-	-
A30 =	1.40633599E-06	-	-	-

[0119] In the 3rd embodiment, the equation of the aspheric surface profiles of the aforementioned lens elements is the same as the equation of the 1st embodiment. Also, the definitions of these parameters shown in the following table are the same as those stated in the 1st embodiment with corresponding values for the 3rd embodiment, so an explanation in this regard will not be provided again.

[0120] Moreover, these parameters can be calculated from Table 5 and Table 6 as the following values and satisfy the following conditions:

3rd Embodiment				
f [mm]	2.64	(R7+R8)/(R7-R8)	3.28
Fno	2.00	(R11+R12)/(R11-R12)	8.58
HFOV [deg.]	59.9	|R11/R9|+|R12/R10|	0.22
(V2+V4)/(V3+V5)	2.96	R4/CT2	-2.35
V4/V5	3.05	R7/f4	-0.64
V5+V6	55.8	|f/R1|	0.23
V1/N1	36.30	|f/R1|+|f/R2|	0.53
V2/N2	36.26	|f2/f1|+|f2/f3|	0.54
V3/N3	11.65	f/f5+f/f6	-0.55
V4/N4	36.26	EPD/Y11	1.99
V5/N5	10.90	tan(HFOV)xY62/Y11	6.76
V6/N6	23.91	Y62/Y11	3.92
(CT1+CT2)/T12	6.00	YS/Y11	1.00
(CT3+CT4)/T34	2.76	Yc52/Yc51	1.11
(CT4+CT5+CT6)/(T45+T56)	23.73	Yc62/Yc61	1.45
TL/ImgH	1.53	-	-

4th Embodiment

[0121]   Fig. 7 is a schematic view of an image capturing unit according to the 4th embodiment of the present disclosure. Fig. 8 shows, in order from left to right, spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 4th embodiment. In Fig. 7, the image capturing unit 4 includes the image capturing system (its reference numeral is omitted) of the present disclosure and an image sensor IS. The image capturing system includes, in order from an object side to an image side along an optical axis, a stop S1, an aperture stop ST, a first lens element E1, a stop S2, a second lens element E2, a stop S3, a third lens element E3, a fourth lens element E4, a fifth lens element E5, a sixth lens element E6, a filter E7 and an image surface IMG. The image capturing system includes six lens elements (E1, E2, E3, E4, E5 and E6) with no additional lens element disposed between each of the adjacent six lens elements.

[0122]   The first lens element E1 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The first lens element E1 is made of plastic material and has the object-side surface and the image-side surface being both aspheric.

[0123]   The second lens element E2 with positive refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The second lens element E2 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the second lens element E2 has one inflection point.

[0124]   The third lens element E3 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The third lens element E3 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The image-side surface of the third lens element E3 has one inflection point.

[0125]   The fourth lens element E4 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fourth lens element E4 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fourth lens element E4 has one inflection point. The image-side surface of the fourth lens element E4 has one inflection point.

[0126]   The fifth lens element E5 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fifth lens element E5 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fifth lens element E5 has two inflection points. The image-side surface of the fifth lens element E5 has two inflection points. The object-side surface of the fifth lens element E5 has one concave critical point in an off-axis

region thereof. The image-side surface of the fifth lens element E5 has one convex critical point in an off-axis region thereof.

[0127] The sixth lens element E6 with negative refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The sixth lens element E6 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the sixth lens element E6 has two inflection points. The image-side surface of the sixth lens element E6 has one inflection point. The object-side surface of the sixth lens element E6 has one concave critical point in an off-axis region thereof. The image-side surface of the sixth lens element E6 has one convex critical point in an off-axis region thereof.

[0128] The filter E7 is made of glass material and located between the sixth lens element E6 and the image surface IMG, and will not affect the focal length of the image capturing system. The image sensor IS is disposed on or near the image surface IMG of the image capturing system.

[0129] The detailed optical data of the 4th embodiment are shown in Table 7 and the aspheric surface data are shown in Table 8 below.

TABLE 7							
4th Embodiment							
f = 2.62 mm, Fno = 2.00, HFOV = 59.9 deg.							
Surface #		Curvature Radius		Thickness	Material	Index	Abbe #	Focal Length
0	Object	Plano		400.000				
1	Stop	Plano		0.108				
2	Ape. Stop	Plano		0.063				
3	Lens 1	-147.6630	(ASP)	0.261	Plastic	1.545	56.1	22.37
4		-11.2666	(ASP)	0.047				
5	Stop	Plano		0.092				
6	Lens 2	45.0919	(ASP)	0.547	Plastic	1.544	56.0	2.53
7		-1.4134	(ASP)	-0.234				
8	Stop	Plano		0.264				
9	Lens 3	-3.2648	(ASP)	0.354	Plastic	1.669	19.5	-4.83
10		328.9565	(ASP)	0.334				
11	Lens 4	-2.0864	(ASP)	0.758	Plastic	1.544	56.0	2.46
12		-0.9208	(ASP)	0.030				
13	Lens 5	-3.3138	(ASP)	0.297	Plastic	1.686	18.4	-9.05
14		-7.3683	(ASP)	0.034				
15	Lens 6	0.6955	(ASP)	0.300	Plastic	1.566	37.4	-6.55
16		0.4943	(ASP)	0.900				
17	Filter	Plano		0.210	Glass	1.517	64.2	-
18		Plano		0.435				
19	Image	Plano		-				
Note: Reference wavelength is 587.6 nm (d-line).								
An effective radius of the stop S1 (Surface 1) is 0.836 mm.								
An effective radius of the stop S2 (Surface 5) is 0.719 mm.								
An effective radius of the stop S3 (Surface 8) is 0.845 mm.								

TABLE 8				
Aspheric Coefficients				
Surface #	3	4	6	7
k =	0.00000E+00	-3.49045E+01	0.00000E+00	-2.93423E+00
A4 =	-1.89259451E-01	-3.39508135E-01	-2.61257857E-01	-1.98094629E-01
A6 =	-3.11736631E-02	-7.63204376E-02	-2.50736364E-01	-3.63790031E-01
A8 =	-8.26567852E-02	1.30116476E-01	1.32722557E-01	1.32977344E+00
A10 =	-4.04190722E-01	4.21695432E-01	5.58825099E-01	-2.41612191E+00
A12 =	1.73058800E+00	-7.63836673E-01	-1.43026401E+00	2.20959156E+00
A14 =	-2.04950458E+00	-	2.23244420E+00	-1.00513572E+00
A16 =	-	-	-3.09218443E+00	-
Surface #	9	10	11	12
k =	-2.14599E+01	0.00000E+00	-1.00000E+00	-2.56461E+00
A4 =	-2.44625773E-01	-1.98737568E-01	-2.73420868E-01	-2.03868750E-01
A6 =	-1.03531022E-01	1.69395229E-01	2.30278650E-01	4.42675076E-01
A8 =	1.37401257E+00	3.45721990E-02	1.73881170E-01	-1.00488419E+00
A10 =	-3.61130420E+00	-2.25205611E-01	-3.60057628E-01	1.33517061E+00
A12 =	5.31239657E+00	1.81093297E-01	2.28702129E-01	-1.03075918E+00
A14 =	-5.16096465E+00	-6.32858193E-02	-6.46984761 E-02	4.53409789E-01
A16 =	2.88703574E+00	8.28137475E-03	6.72438433E-03	-1.03183289E-01
A18 =	-6.49496275E-01	-	-	9.31817383E-03
Surface #	13	14	15	16
k =	0.00000E+00	-9.00000E+01	-3.22775E+00	-2.54154E+00
A4 =	6.43737524E-01	5.85134987E-01	6.93386057E-02	-4.97849303E-02
A6 =	-7.41458643E-01	-6.50379306E-01	-2.57584298E-01	-3.40663184E-02
A8 =	7.11921474E-01	3.87578468E-01	2.64636992E-01	3.20551527E-02
A10 =	-9.48055023E-01	-1.35994248E-01	-1.84986351E-01	-1.48775061E-02
A12 =	1.40510389E+00	2.20391156E-02	8.38513296E-02	4.43159129E-03
A14 =	-1.63167276E+00	1.79066522E-03	-2.38890529E-02	-8.31706945E-04
A16 =	1.35505646E+00	-1.53459682E-03	4.24592220E-03	9.19535443E-05
A18 =	-7.99333029E-01	2.91677157E-04	-4.57433520E-04	-5.26886749E-06
A20 =	3.34689864E-01	-2.52526160E-05	2.73461908E-05	1.02769356E-07
A22 =	-9.84334098E-02	8.54949231E-07	-6.96173200E-07	1.34207000E-09
A24 =	1.98047751E-02	-	-	-
A26 =	-2.58623547E-03	-	-	-
A28 =	1.96819338E-04	-	-	-
A30 =	-6.60460371 E-06	-	-	-

[0130]   In the 4th embodiment, the equation of the aspheric surface profiles of the aforementioned lens elements is the same as the equation of the 1st embodiment. Also, the definitions of these parameters shown in the following table

are the same as those stated in the 1st embodiment with corresponding values for the 4th embodiment, so an explanation in this regard will not be provided again.

[0131]   Moreover, these parameters can be calculated from Table 7 and Table 8 as the following values and satisfy the following conditions:

4th Embodiment			
f [mm]	2.62	(R7+R8)/(R7-R8)	2.58
Fno	2.00	(R11+R12)/(R11-R12)	5.91
HFOV [deg.]	59.9	|R11/R9|+|R12/R10|	0.28
(V2+V4)/(V3+V5)	2.96	R4/CT2	-2.58
V4/V5	3.05	R7/f4	-0.85
V5+V6	55.8	|f/R1|	0.02
V1/N1	36.30	|f/R1|+|f/R2|	0.25
V2/N2	36.26	|f2/f1|+|f2/f3|	0.64
V3/N3	11.65	f/f5+f/f6	-0.69
V4/N4	36.26	EPD/Y11	1.99
V5/N5	10.90	tan(HFOV)xY62/Y11	6.55
V6/N6	23.91	Y62/Y11	3.80
(CT1+CT2)/T12	5.81	YS/Y11	1.00
(CT3+CT4)/T34	3.33	Yc52/Yc51	1.11
(CT4+CT5+CT6)/(T45+T56)	21.17	Yc62/Yc61	1.31
TL/ImgH	1.51	-	-

5th Embodiment

[0132]   Fig. 9 is a schematic view of an image capturing unit according to the 5th embodiment of the present disclosure. Fig. 10 shows, in order from left to right, spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 5th embodiment. In Fig. 9, the image capturing unit 5 includes the image capturing system (its reference numeral is omitted) of the present disclosure and an image sensor IS. The image capturing system includes, in order from an object side to an image side along an optical axis, a stop S1, an aperture stop ST, a first lens element E1, a stop S2, a second lens element E2, a stop S3, a third lens element E3, a fourth lens element E4, a fifth lens element E5, a sixth lens element E6, a filter E7 and an image surface IMG. The image capturing system includes six lens elements (E1, E2, E3, E4, E5 and E6) with no additional lens element disposed between each of the adjacent six lens elements.

[0133]   The first lens element E1 with positive refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The first lens element E1 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the first lens element E1 has one inflection point.

[0134]   The second lens element E2 with positive refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The second lens element E2 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the second lens element E2 has one inflection point.

[0135]   The third lens element E3 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The third lens element E3 is made of plastic material and has the object-side surface and the image-side surface being both aspheric.

[0136]   The fourth lens element E4 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fourth lens element E4 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fourth lens element E4 has one inflection point. The image-side surface of the fourth lens element E4 has one inflection point.

[0137]   The fifth lens element E5 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fifth lens element E5 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fifth lens element E5 has three inflection points. The image-side surface of the fifth lens element E5 has three inflection points. The object-side surface of the fifth lens element E5 has one concave critical point in an off-axis region thereof. The image-side surface of the fifth lens element E5 has one convex critical point in an off-axis region thereof.

[0138]   The sixth lens element E6 with negative refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The sixth lens element E6 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the sixth lens element E6 has two inflection points. The image-side surface of the sixth lens element E6 has two inflection points. The object-side surface of the sixth lens element E6 has one concave critical point in an off-axis region thereof. The image-side surface of the sixth lens element E6 has one convex critical point in an off-axis region thereof.

[0139]   The filter E7 is made of glass material and located between the sixth lens element E6 and the image surface IMG, and will not affect the focal length of the image capturing system. The image sensor IS is disposed on or near the image surface IMG of the image capturing system.

[0140]   The detailed optical data of the 5th embodiment are shown in Table 9 and the aspheric surface data are shown in Table 10 below.

TABLE 9							
5th Embodiment							
f = 2.64 mm, Fno = 2.00, HFOV = 59.9 deg.							
Surface #		Curvature Radius		Thickness	Material	Index	Abbe #	Focal Length
0	Object	Plano		400.000				
1	Stop	Plano		0.108				
2	Ape. Stop	Plano		0.087				
3	Lens 1	197.3443	(ASP)	0.273	Plastic	1.545	56.1	30.57
4		-18.1884	(ASP)	0.032				
5	Stop	Plano		0.107				
6	Lens 2	18.1316	(ASP)	0.584	Plastic	1.544	56.0	2.88
7		-1.6961	(ASP)	-0.220				
8	Stop	Plano		0.278				
9	Lens 3	-5.5799	(ASP)	0.240	Plastic	1.669	19.5	-8.84
10		-100.0000	(ASP)	0.361				
11	Lens 4	-1.6578	(ASP)	0.734	Plastic	1.544	56.0	2.28
12		-0.8206	(ASP)	0.030				
13	Lens 5	-3.3232	(ASP)	0.285	Plastic	1.686	18.4	-8.36
14		-8.1794	(ASP)	0.046				
15	Lens 6	0.7743	(ASP)	0.323	Plastic	1.566	37.4	-4.51
16		0.5044	(ASP)	0.900				
17	Filter	Plano		0.210	Glass	1.517	64.2	-
18		Plano		0.373				
19	Image	Plano		-				
Note: Reference wavelength is 587.6 nm (d-line).								
An effective radius of the stop S1 (Surface 1) is 0.842 mm.								
An effective radius of the stop S2 (Surface 5) is 0.727 mm.								

(continued)

TABLE 9							
5th Embodiment							
f = 2.64 mm, Fno = 2.00, HFOV = 59.9 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal Length
An effective radius of the stop S3 (Surface 8) is 0.924 mm.							

TABLE 10				
Aspheric Coefficients				
Surface #	3	4	6	7
k =	0.00000E+00	-1.00000E+00	0.00000E+00	-2.46333E+00
A4 =	-1.90569782E-01	-3.60240280E-01	-2.59644763E-01	8.64058118E-02
A6 =	-1.28513771E-01	-1.45260235E-01	-4.54866365E-01	-2.21032026E+00
A8 =	6.56273023E-01	8.07438466E-02	7.74496970E-01	5.85099783E+00
A10 =	-3.36269648E+00	6.38722778E-01	-2.55564705E+00	-8.01546575E+00
A12 =	7.11470129E+00	-1.04952638E+00	6.29471331E+00	5.71604191E+00
A14 =	-6.06714021E+00	-	-6.75874323E+00	-1.81713666E+00
A16 =	-	-	9.00015620E-01	-
Surface #	9	10	11	12
k =	-1.18090E+01	0.00000E+00	-1.71695E+00	-2.67555E+00
A4 =	1.50178159E-01	-1.66675069E-02	-2.49410115E-01	-2.57156510E-01
A6 =	-2.33735478E+00	-6.40487492E-01	3.14423151E-01	5.37420315E-01
A8 =	5.86801951E+00	1.44032967E+00	-8.37206615E-02	-1.10841175E+00
A10 =	-7.23592247E+00	-1.51056694E+00	-1.03710982E-01	1.46305879E+00
A12 =	4.97756299E+00	8.18023238E-01	1.10717516E-01	-1.15717738E+00
A14 =	-2.28832363E+00	-2.23693078E-01	-3.86683325E-02	5.23774147E-01
A16 =	8.19998757E-01	2.43094450E-02	4.47522748E-03	-1.22159650E-01
A18 =	-1.58417854E-01	-	-	1.12484309E-02
Surface #	13	14	15	16
k =	0.00000E+00	-5.50577E+01	-4.80894E+00	-3.09120E+00
A4 =	6.52027630E-01	6.51985930E-01	1.60868895E-01	-9.12088197E-03
A6 =	-8.80649792E-01	-8.78368404E-01	-3.83626898E-01	-8.20843503E-02
A8 =	1.04262643E+00	6.70104158E-01	3.62737272E-01	6.80987702E-02
A10 =	-1.46661690E+00	-3.32270445E-01	-2.40930335E-01	-3.24490477E-02
A12 =	2.00891182E+00	1.06345060E-01	1.08911194E-01	1.02964556E-02
A14 =	-2.16612050E+00	-2.11958882E-02	-3.18956519E-02	-2.18668404E-03
A16 =	1.72288928E+00	2.42197206E-03	5.90578602E-03	3.02236743E-04
A18 =	-9.99371495E-01	-1.22489865E-04	-6.65803940E-04	-2.59083505E-05
A20 =	4.19651818E-01	-1.28832668E-06	4.16622583E-05	1.24945142E-06

(continued)

TABLE 10			
Aspheric Coefficients			
A22 =	-1.25503805E-01	2.69843175E-07	-1.10834298E-06	-2.59523729E-08
A24 =	2.59110559E-02	-	-	-
A26 =	-3.49031674E-03	-	-	-
A28 =	2.74649108E-04	-	-	-
A30 =	-9.53250351E-06	-	-	-

[0141] In the 5th embodiment, the equation of the aspheric surface profiles of the aforementioned lens elements is the same as the equation of the 1st embodiment. Also, the definitions of these parameters shown in the following table are the same as those stated in the 1st embodiment with corresponding values for the 5th embodiment, so an explanation in this regard will not be provided again.

[0142] Moreover, these parameters can be calculated from Table 9 and Table 10 as the following values and satisfy the following conditions:

5th Embodiment			
f [mm]	2.64	(R7+R8)/(R7-R8)	2.96
Fno	2.00	(R11+R12)/(R11-R12)	4.74
HFOV [deg.]	59.9	|R11/R9|+|R12/R10|	0.29
(V2+V4)/(V3+V5)	2.96	R4/CT2	-2.90
V4/V5	3.05	R7/f4	-0.73
V5+V6	55.8	|f/R1|	0.01
V1/N1	36.30	|f/R1|+|f/R2|	0.16
V2/N2	36.26	|f2/f1|+|f2/f3|	0.42
V3/N3	11.65	f/f5+f/f6	-0.90
V4/N4	36.26	EPD/Y11	1.99
V5/N5	10.90	tan(HFOV)xY62/Y11	6.44
V6/N6	23.91	Y62/Y11	3.74
(CT1+CT2)/T12	6.17	YS/Y11	0.99
(CT3+CT4)/T34	2.70	Yc52/Yc51	1.11
(CT4+CT5+CT6)/(T45+T56)	17.66	Yc62/Yc61	1.36
TL/ImgH	1.48	-	-

6th Embodiment

[0143] Fig. 11 is a schematic view of an image capturing unit according to the 6th embodiment of the present disclosure. Fig. 12 shows, in order from left to right, spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 6th embodiment. In Fig. 11, the image capturing unit 6 includes the image capturing system (its reference numeral is omitted) of the present disclosure and an image sensor IS. The image capturing system includes, in order from an object side to an image side along an optical axis, a stop S1, an aperture stop ST, a first lens element E1, a stop S2, a second lens element E2, a stop S3, a third lens element E3, a fourth lens element E4, a fifth lens element E5, a sixth lens element E6, a filter E7 and an image surface IMG. The image capturing system includes six lens elements (E1, E2, E3, E4, E5 and E6) with no additional lens element disposed between each of the adjacent six lens elements.

[0144] The first lens element E1 with positive refractive power has an object-side surface being concave in a paraxial

region thereof and an image-side surface being convex in a paraxial region thereof. The first lens element E1 is made of plastic material and has the object-side surface and the image-side surface being both aspheric.

[0145]   The second lens element E2 with positive refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The second lens element E2 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the second lens element E2 has one inflection point.

[0146]   The third lens element E3 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The third lens element E3 is made of plastic material and has the object-side surface and the image-side surface being both aspheric.

[0147]   The fourth lens element E4 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fourth lens element E4 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fourth lens element E4 has one inflection point. The image-side surface of the fourth lens element E4 has one inflection point.

[0148]   The fifth lens element E5 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fifth lens element E5 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fifth lens element E5 has two inflection points. The image-side surface of the fifth lens element E5 has three inflection points. The object-side surface of the fifth lens element E5 has one concave critical point in an off-axis region thereof. The image-side surface of the fifth lens element E5 has one convex critical point in an off-axis region thereof.

[0149]   The sixth lens element E6 with negative refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The sixth lens element E6 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the sixth lens element E6 has two inflection points. The image-side surface of the sixth lens element E6 has one inflection point. The object-side surface of the sixth lens element E6 has one concave critical point in an off-axis region thereof. The image-side surface of the sixth lens element E6 has one convex critical point in an off-axis region thereof.

[0150]   The filter E7 is made of glass material and located between the sixth lens element E6 and the image surface IMG, and will not affect the focal length of the image capturing system. The image sensor IS is disposed on or near the image surface IMG of the image capturing system.

[0151]   The detailed optical data of the 6th embodiment are shown in Table 11 and the aspheric surface data are shown in Table 12 below.

TABLE 11							
6th Embodiment							
f = 2.66 mm, Fno = 2.00, HFOV = 59.9 deg.							
Surface #		Curvature Radius		Thickness	Material	Index	Abbe #	Focal Length
0	Object	Plano		400.000				
1	Stop	Plano		0.108				
2	Ape. Stop	Plano		0.103				
3	Lens 1	-13.3861	(ASP)	0.275	Plastic	1.545	56.1	89.00
4		-10.5667	(ASP)	-0.083				
5	Stop	Plano		0.210				
6	Lens 2	8.9848	(ASP)	0.522	Plastic	1.544	56.0	2.21
7		-1.3585	(ASP)	-0.318				
8	Stop	Plano		0.348				
9	Lens 3	-2.7817	(ASP)	0.246	Plastic	1.669	19.5	-4.32
10		-76.3045	(ASP)	0.405				

(continued)

TABLE 11								
6th Embodiment								
f = 2.66 mm, Fno = 2.00, HFOV = 59.9 deg.								
Surface #		Curvature Radius		Thickness	Material	Index	Abbe #	Focal Length
11	Lens 4	-1.8678	(ASP)	0.703	Plastic	1.544	56.0	2.43
12		-0.8770	(ASP)	0.030				
13	Lens 5	-3.8891	(ASP)	0.308	Plastic	1.686	18.4	-9.81
14		-9.5070	(ASP)	0.110				
15	Lens 6	0.7524	(ASP)	0.300	Plastic	1.566	37.4	-5.03
16		0.5095	(ASP)	0.900				
17	Filter	Plano		0.210	Glass	1.517	64.2	-
18		Plano		0.389				
19	Image	Plano		-				
Note: Reference wavelength is 587.6 nm (d-line).								
An effective radius of the stop S1 (Surface 1) is 0.847 mm.								
An effective radius of the stop S2 (Surface 5) is 0.721 mm.								
An effective radius of the stop S3 (Surface 8) is 0.843 mm.								

TABLE 12				
Aspheric Coefficients				
Surface #	3	4	6	7
k =	0.00000E+00	-8.29170E+01	0.00000E+00	-3.14409E+00
A4 =	-2.01483813E-01	-4.03610707E-01	-3.07482603E-01	1.38981579E-01
A6 =	1.82730666E-02	-3.55409687E-02	-3.29118478E-01	-2.32313197E+00
A8 =	-1.87997312E-01	2.33414042E-01	-2.60116050E-02	6.55504684E+00
A10 =	-1.54784682E-01	1.99489683E-01	1.76092582E+00	-1.04602415E+01
A12 =	1.43372748E+00	-7.04371604E-01	-6.22761468E+00	8.90724249E+00
A14 =	-2.03766016E+00	-	1.08704041E+01	-3.40530085E+00
A16 =	-	-	-9.67667207E+00	-
Surface #	9	10	11	12
k =	-5.98063E+01	0.00000E+00	-1.17614E+00	-3.61687E+00
A4 =	-1.93799125E-01	-1.85816140E-01	-3.41075681E-01	-3.25514044E-01
A6 =	-7.65061310E-01	1.92417121E-01	5.62075426E-01	5.36761012E-01

(continued)

TABLE 12				
Aspheric Coefficients				
Surface #	3	4	6	7
A8 =	3.14429897E+00	3.07818306E-02	-3.89902690E-01	-9.45608756E-01
A10 =	-5.06981486E+00	-3.40286587E-01	8.85682864E-02	1.17042711E+00
A12 =	3.89838167E+00	3.21749937E-01	5.36169073E-02	-9.14982794E-01
A14 =	-1.37265325E+00	-1.23898585E-01	-3.31889863E-02	4.22486073E-01
A16 =	1.92700858E-01	1.71380635E-02	4.69322786E-03	-1.01744371E-01
A18 =	-1.26020440E-02	-	-	9.69302253E-03
Surface #	13	14	15	16
k =	0.00000E+00	-8.83124E+01	-3.60661E+00	-2.68998E+00
A4 =	7.12907847E-01	6.08714335E-01	1.02934225E-02	-9.09073939E-02
A6 =	-1.03984421E+00	-7.44915419E-01	-1.54243556E-01	3.20948592E-02
A8 =	1.23527872E+00	5.26657853E-01	1.68993897E-01	-2.11994405E-02
A10 =	-1.40925607E+00	-2.57787425E-01	-1.29958127E-01	1.07653342E-02
A12 =	1.42468773E+00	8.81513313E-02	6.42217070E-02	-3.10105239E-03
A14 =	-1.16723590E+00	-2.06193767E-02	-1.96249837E-02	5.00923814E-04
A16 =	7.38435517E-01	3.18924543E-03	3.70505387E-03	-4.18797581E-05
A18 =	-3.52516946E-01	-3.07864813E-04	-4.21764573E-04	1.00824644E-06
A20 =	1.24916657E-01	1.65639686E-05	2.65538566E-05	8.65076033E-08
A22 =	-3.21819323E-02	-3.73053478E-07	-7.10089439E-07	-4.83518562E-09
A24 =	5.82884207E-03	-	-	-
A26 =	-7.00089268E-04	-	-	-
A28 =	4.98157641E-05	-	-	-
A30 =	-1.58208726E-06	-	-	-

[0152] In the 6th embodiment, the equation of the aspheric surface profiles of the aforementioned lens elements is the same as the equation of the 1st embodiment. Also, the definitions of these parameters shown in the following table are the same as those stated in the 1st embodiment with corresponding values for the 6th embodiment, so an explanation in this regard will not be provided again.

[0153] Moreover, these parameters can be calculated from Table 11 and Table 12 as the following values and satisfy the following conditions:

6th Embodiment			
f [mm]	2.66	(R7+R8)/(R7-R8)	2.77
Fno	2.00	(R11+R12)/(R11-R12)	5.19
HFOV [deg.]	59.9	|R11/R9|+|R12/R10|	0.25
(V2+V4)/(V3+V5)	2.96	R4/CT2	-2.60
V4/V5	3.05	R7/f4	-0.77
V5+V6	55.8	|f/R1|	0.20
V1/N1	36.30	|f/R1|+|f/R2|	0.45

(continued)

6th Embodiment			
V2/N2	36.26	|f2/f1|+|f2/f3|	0.54
V3/N3	11.65	f/f5+f/f6	-0.80
V4/N4	36.26	EPD/Y11	1.99
V5/N5	10.90	tan(HFOV)xY62/Y11	6.43
V6/N6	23.91	Y62/Y11	3.73
(CT1+CT2)/T12	6.28	YS/Y11	0.99
(CT3+CT4)/T34	2.34	Yc52/Yc51	1.08
(CT4+CT5+CT6)/(T45+T56)	9.36	Yc62/Yc61	1.34
TL/ImgH	1.48	-	-

7th Embodiment

[0154] Fig. 13 is a schematic view of an image capturing unit according to the 7th embodiment of the present disclosure. Fig. 14 shows, in order from left to right, spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 7th embodiment. In Fig. 13, the image capturing unit 7 includes the image capturing system (its reference numeral is omitted) of the present disclosure and an image sensor IS. The image capturing system includes, in order from an object side to an image side along an optical axis, a stop S1, an aperture stop ST, a first lens element E1, a second lens element E2, a stop S2, a third lens element E3, a fourth lens element E4, a fifth lens element E5, a sixth lens element E6, a filter E7 and an image surface IMG. The image capturing system includes six lens elements (E1, E2, E3, E4, E5 and E6) with no additional lens element disposed between each of the adjacent six lens elements.

[0155] The first lens element E1 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The first lens element E1 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The image-side surface of the first lens element E1 has one inflection point.

[0156] The second lens element E2 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The second lens element E2 is made of glass material and has the object-side surface and the image-side surface being both aspheric.

[0157] The third lens element E3 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The third lens element E3 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The image-side surface of the third lens element E3 has one inflection point.

[0158] The fourth lens element E4 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fourth lens element E4 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fourth lens element E4 has one inflection point. The image-side surface of the fourth lens element E4 has one inflection point.

[0159] The fifth lens element E5 with negative refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The fifth lens element E5 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fifth lens element E5 has three inflection points. The image-side surface of the fifth lens element E5 has four inflection points. The object-side surface of the fifth lens element E5 has one concave critical point in an off-axis region thereof. The image-side surface of the fifth lens element E5 has one convex critical point in an off-axis region thereof.

[0160] The sixth lens element E6 with negative refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The sixth lens element E6 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the sixth lens element E6 has two inflection points. The image-side surface of the sixth lens element E6 has one inflection point. The object-side surface of the sixth lens element E6 has one concave critical point in an off-axis region thereof. The image-side surface of the sixth lens element E6 has one convex critical point in an off-axis region thereof.

[0161] The filter E7 is made of glass material and located between the sixth lens element E6 and the image surface IMG, and will not affect the focal length of the image capturing system. The image sensor IS is disposed on or near the image surface IMG of the image capturing system.

[0162] The detailed optical data of the 7th embodiment are shown in Table 13 and the aspheric surface data are shown in Table 14 below.

TABLE 13							
7th Embodiment							
f = 2.63 mm, Fno = 1.99, HFOV = 59.9 deg.							
Surface #		Curvature Radius	Thickness	Material	Index	Abbe #	Focal Length
0	Object	Plano	400.000				
1	Stop	Plano		0.108			
2	Ape. Stop	Plano		0.115			
3	Lens 1	-265.3588	(ASP)	0.270	Plastic	1.566	37.4	-297.44
4		460.8295	(ASP)	0.102			
5	Lens 2	-10.2227	(ASP)	0.348	Glass	1.610	57.9	2.59
6		-1.3885	(ASP)	-0.215			
7	Stop	Plano		0.245			
8	Lens 3	-18.7587	(ASP)	0.373	Plastic	1.705	14.0	-8.10
9		8.2709	(ASP)	0.346			
10	Lens 4	-1.8616	(ASP)	0.778	Plastic	1.529	60.1	2.87
11		-0.9562	(ASP)	0.162			
12	Lens 5	-8.8083	(ASP)	0.285	Plastic	1.686	18.4	-12.42
13		261.7801	(ASP)	0.174			
14	Lens 6	0.9203	(ASP)	0.300	Plastic	1.639	23.5	-4.85
15		0.6192	(ASP)	0.900			
16	Filter	Plano		0.210	Glass	1.517	64.2	-
17		Plano		0.171			
18	Image	Plano		-			
Note: Reference wavelength is 587.6 nm (d-line).							
An effective radius of the stop S1 (Surface 1) is 0.845 mm.							
An effective radius of the stop S2 (Surface 7) is 0.749 mm.							

TABLE 14				
Aspheric Coefficients				
Surface #	3	4	5	6
k =	0.00000E+00	-9.90000E+01	0.00000E+00	-3.71831E+00
A4 =	-2.30274820E-01	-3.57324289E-01	-1.83422018E-01	-7.08457987E-02
A6 =	-1.48565769E-01	-3.34990859E-01	-3.90689220E-01	-3.43024017E-01
A8 =	5.98689343E-01	-3.51790557E-01	-7.99411710E-01	-3.45907989E-01
A10 =	-3.54388759E+00	3.22130211E+00	2.26514629E+00	2.75333584E+00

(continued)

TABLE 14			
Aspheric Coefficients			
Surface #	3	4	5	6
A12 =	9.03509585E+00	-3.79497307E+00	5.24189168E+00	-4.19741463E+00
A14 =	-8.81026437E+00	-	-1.70668792E+01	1.88767356E+00
A16 =	-	-	1.00317492E+01	-
Surface #	8	9	10	11
k =	-4.09007E+01	0.00000E+00	-5.38579E+00	-3.28835E+00
A4 =	-8.47872740E-02	-1.60850194E-01	-7.87281930E-02	5.69441692E-02
A6 =	-1.26520484E-01	2.00317197E-01	2.26495310E-01	-5.06719388E-01
A8 =	-3.99590707E-01	-4.79791355E-01	-4.34961396E-01	8.51249250E-01
A10 =	2.36174313E+00	7.26547808E-01	4.49813247E-01	-9.34984932E-01
A12 =	-4.35323200E+00	-6.61039280E-01	-2.36161797E-01	6.86939182E-01
A14 =	3.16346564E+00	3.31151875E-01	6.37580076E-02	-3.21698945E-01
A16 =	-3.99797056E-01	-7.02755456E-02	-7.13629186E-03	8.62871905E-02
A18 =	-3.11052154E-01	-	-	-9.58651388E-03
Surface #	12	13	14	15
k =	0.00000E+00	-9.90000E+01	-5.64960E+00	-2.68108E+00
A4 =	6.44309162E-01	2.30738990E-01	-1.22720675E-01	-2.79601319E-01
A6 =	-1.05130135E+00	3.24947539E-01	-1.64799900E-01	2.43898542E-01
A8 =	1.02773103E+00	-1.35009088E+00	3.63101949E-01	-1.93130321E-01
A10 =	1.79915494E-01	1.74145708E+00	-4.49786523E-01	1.14004737E-01
A12 =	-3.54235763E+00	-1.29119960E+00	3.20174443E-01	-4.47911644E-02
A14 =	7.80671722E+00	6.03270993E-01	-1.32714414E-01	1.14899250E-02
A16 =	-9.81082189E+00	-1.78667373E-01	3.28814406E-02	-1.90884470E-03
A18 =	8.15653338E+00	3.23877438E-02	-4.81541448E-03	1.98511336E-04
A20 =	-4.68856817E+00	-3.26900073E-03	3.85209118E-04	-1.17691488E-05
A22 =	1.87860008E+00	1.40436637E-04	-1.29930003E-05	3.03967950E-07
A24 =	-5.15869817E-01	-	-	-
A26 =	9.25996359E-02	-	-	-
A28 =	-9.78570041E-03	-	-	-
A30 =	4.61396002E-04	-	-	-

[0163] In the 7th embodiment, the equation of the aspheric surface profiles of the aforementioned lens elements is the same as the equation of the 1st embodiment. Also, the definitions of these parameters shown in the following table are the same as those stated in the 1st embodiment with corresponding values for the 7th embodiment, so an explanation in this regard will not be provided again.

[0164] Moreover, these parameters can be calculated from Table 13 and Table 14 as the following values and satisfy the following conditions:

7th Embodiment			
f [mm]	2.63	(R7+R8)/(R7-R8)	3.11
Fno	1.99	(R11+R12)/(R11-R12)	5.11
HFOV [deg.]	59.9	|R11/R9|+|R12/R10|	0.11
(V2+V4)/(V3+V5)	3.64	R4/CT2	-3.99
V4/V5	3.27	R7/f4	-0.65
V5+V6	41.9	|f/R1|	0.01
V1/N1	23.91	|f/R1|+|f/R2|	0.02
V2/N2	35.97	|f2/f1|+|f2/f3|	0.33
V3/N3	8.24	f/f5+f/f6	-0.76
V4/N4	39.31	EPD/Y11	2.00
V5/N5	10.90	tan(HFOV)xY62/Y11	6.27
V6/N6	14.34	Y62/Y11	3.64
(CT1+CT2)/T12	6.06	YS/Y11	1.00
(CT3+CT4)/T34	3.33	Yc52/Yc51	0.97
(CT4+CT5+CT6)/(T45+T56)	4.06	Yc62/Yc61	1.64
TL/ImgH	1.45	-	-

8th Embodiment

[0165] Fig. 15 is a schematic view of an image capturing unit according to the 8th embodiment of the present disclosure. Fig. 16 shows, in order from left to right, spherical aberration curves, astigmatic field curves and a distortion curve of the image capturing unit according to the 8th embodiment. In Fig. 15, the image capturing unit 8 includes the image capturing system (its reference numeral is omitted) of the present disclosure and an image sensor IS. The image capturing system includes, in order from an object side to an image side along an optical axis, a stop S1, an aperture stop ST, a first lens element E1, a stop S2, a second lens element E2, a stop S3, a third lens element E3, a fourth lens element E4, a fifth lens element E5, a sixth lens element E6, a filter E7 and an image surface IMG. The image capturing system includes six lens elements (E1, E2, E3, E4, E5 and E6) with no additional lens element disposed between each of the adjacent six lens elements.

[0166] The first lens element E1 with positive refractive power has an object-side surface being planar in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The first lens element E1 is made of plastic material and has the object-side surface and the image-side surface being both aspheric.

[0167] The second lens element E2 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The second lens element E2 is made of plastic material and has the object-side surface and the image-side surface being both aspheric.

[0168] The third lens element E3 with negative refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The third lens element E3 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the third lens element E3 has one inflection point. The image-side surface of the third lens element E3 has one inflection point.

[0169] The fourth lens element E4 with positive refractive power has an object-side surface being concave in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fourth lens element E4 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fourth lens element E4 has one inflection point. The image-side surface of the fourth lens element E4 has one inflection point.

[0170] The fifth lens element E5 with positive refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being convex in a paraxial region thereof. The fifth lens element E5 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the fifth lens element E5 has two inflection points. The image-side surface of the fifth lens element E5 has four inflection points. The object-side surface of the fifth lens element E5 has one concave critical point in an off-axis

region thereof. The image-side surface of the fifth lens element E5 has one convex critical point in an off-axis region thereof.

[0171] The sixth lens element E6 with negative refractive power has an object-side surface being convex in a paraxial region thereof and an image-side surface being concave in a paraxial region thereof. The sixth lens element E6 is made of plastic material and has the object-side surface and the image-side surface being both aspheric. The object-side surface of the sixth lens element E6 has two inflection points. The image-side surface of the sixth lens element E6 has two inflection points. The object-side surface of the sixth lens element E6 has one concave critical point in an off-axis region thereof. The image-side surface of the sixth lens element E6 has one convex critical point in an off-axis region thereof.

[0172] The filter E7 is made of glass material and located between the sixth lens element E6 and the image surface IMG, and will not affect the focal length of the image capturing system. The image sensor IS is disposed on or near the image surface IMG of the image capturing system.

[0173] The detailed optical data of the 8th embodiment are shown in Table 15 and the aspheric surface data are shown in Table 16 below.

TABLE 15							
8th Embodiment							
f = 2.62 mm, Fno = 1.95, HFOV = 59.8 deg.							
Surface #		Curvature Radius		Thickness	Material	Index	Abbe #	Focal Length
0	Object	Plano		500.000				
1	Stop	Plano		0.108				
2	Ape. Stop	Plano		0.099				
3	Lens 1	∞(infinity)	(ASP)	0.290	Plastic	1.545	56.1	24.52
4		-13.3622	(ASP)	0.018				
5	Stop	Plano		0.128				
6	Lens 2	-114.9828	(ASP)	0.396	Plastic	1.544	56.0	2.66
7		-1.4331	(ASP)	-0.212				
8	Stop	Plano		0.232				
9	Lens 3	404.8583	(ASP)	0.309	Plastic	1.686	18.4	-5.67
10		3.8499	(ASP)	0.339				
11	Lens 4	-1.9513	(ASP)	0.949	Plastic	1.544	56.0	2.09
12		-0.8404	(ASP)	0.020				
13	Lens 5	78.7560	(ASP)	0.285	Plastic	1.686	18.4	91.08
14		-302.1148	(ASP)	0.103				
15	Lens 6	1.2344	(ASP)	0.300	Plastic	1.614	25.6	-2.35
16		0.6038	(ASP)	0.900				
17	Filter	Plano		0.210	Glass	1.517	64.2	-
18		Plano		0.250				
19	Image	Plano		-				
Note: Reference wavelength is 587.6 nm (d-line).								
An effective radius of the stop S1 (Surface 1) is 0.853 mm.								
An effective radius of the stop S2 (Surface 5) is 0.748 mm.								
An effective radius of the stop S3 (Surface 8) is 0.833 mm.								

TABLE 16				
Aspheric Coefficients				
Surface #	3	4	6	7
k =	0.00000E+00	-9.90000E+01	0.00000E+00	-3.39480E+00
A4 =	-2.08109726E-01	-3.48120145E-01	-2.08918199E-01	3.63004439E-03
A6 =	-4.49319097E-02	-2.76290550E-01	-5.64212682E-01	-1.03834305E+00
A8 =	-2.40803376E-01	4.75610414E-01	8.10973469E-01	2.28608186E+00
A10 =	2.15332394E-01	1.25112430E-01	-2.35781949E+00	-3.08627968E+00
A12 =	4.96556403E-01	-6.43693215E-01	7.78105992E+00	2.58223910E+00
A14 =	-1.19493034E+00	-	-1.07821534E+01	-1.29754919E+00
A16 =	-	-	3.77218547E+00	-
Surface #	9	10	11	12
k =	-9.90000E+01	0.00000E+00	-7.18707E+00	-3.10413E+00
A4 =	-1.16315017E-01	-2.41139867E-01	-9.29977079E-02	-1.16709695E-02
A6 =	-4.37903219E-01	3.54714690E-01	2.35457915E-01	-1.67529125E-01
A8 =	1.47178415E+00	-6.93540788E-01	-2.76313451E-01	1.98170871E-01
A10 =	-3.09856491E+00	9.36591129E-01	1.36592312E-01	-1.64179554E-01
A12 =	5.18510986E+00	-8.00446700E-01	7.08569648E-03	1.13000450E-01
A14 =	-6.46921395E+00	3.79766659E-01	-2.44249091E-02	-6.14702706E-02
A16 =	4.60175083E+00	-7.61794686E-02	5.16275141E-03	2.05671054E-02
A18 =	-1.33881008E+00	-	-	-2.68487728E-03
Surface #	13	14	15	16
k =	0.00000E+00	-9.90000E+01	-4.35780E+00	-2.60662E+00
A4 =	1.51538137E-01	1.34587940E-01	-1.06600202E-01	-2.37334543E-01
A6 =	6.27785337E-01	4.50027676E-01	-1.01083097E-01	1.94095803E-01
A8 =	-2.86141746E+00	-1.16151501E+00	1.95820005E-01	-1.44092965E-01
A10 =	6.90170771E+00	1.20475867E+00	-2.15351585E-01	8.10578139E-02
A12 =	-1.19570271E+01	-7.41871606E-01	1.35791050E-01	-3.05954880E-02
A14 =	1.52238217E+01	2.90376400E-01	-4.98414397E-02	7.51992969E-03
A16 =	-1.42727031E+01	-7.22800263E-02	1.09881730E-02	-1.18722473E-03
A18 =	9.85678098E+00	1.10402998E-02	-1.44280805E-03	1.15896508E-04
A20 =	-4.99004286E+00	-9.41974251E-04	1.04374949E-04	-6.34713441E-06
A22 =	1.82511558E+00	3.43490172E-05	-3.21075297E-06	1.48514382E-07
A24 =	-4.68224097E-01	-	-	-
A26 =	7.97282413E-02	-	-	-
A28 =	-8.07285345E-03	-	-	-
A30 =	3.67043590E-04	-	-	-

[0174]   In the 8th embodiment, the equation of the aspheric surface profiles of the aforementioned lens elements is the same as the equation of the 1st embodiment. Also, the definitions of these parameters shown in the following table

are the same as those stated in the 1st embodiment with corresponding values for the 8th embodiment, so an explanation in this regard will not be provided again.

[0175] Moreover, these parameters can be calculated from Table 15 and Table 16 as the following values and satisfy the following conditions:

8th Embodiment			
f [mm]	2.62	(R7+R8)/(R7-R8)	2.51
Fno	1.95	(R11+R12)/(R11-R12)	2.91
HFOV [deg.]	59.8	|R11/R9|+|R12/R10|	0.02
(V2+V4)/(V3+V5)	3.05	R4/CT2	-3.62
V4/V5	3.05	R7/f4	-0.94
V5+V6	44.0	|f/R1|	0.00
V1/N1	36.30	|f/R1|+|f/R2|	0.20
V2/N2	36.26	|f2/f1|+|f2/f3|	0.58
V3/N3	10.90	f/f5+f/f6	-1.09
V4/N4	36.26	EPD/Y11	1.98
V5/N5	10.90	tan(HFOV)xY62/Y11	6.31
V6/N6	15.85	Y62/Y11	3.67
(CT1+CT2)/T12	4.70	YS/Y11	0.99
(CT3+CT4)/T34	3.71	Yc52/Yc51	0.98
(CT4+CT5+CT6)/(T45+T56)	12.47	Yc62/Yc61	1.76
TL/ImgH	1.47	-	-

9th Embodiment

[0176] Fig. 17 is a perspective view of an image capturing unit according to the 9th embodiment of the present disclosure. In this embodiment, an image capturing unit 100 is a camera module including a lens unit 101, a driving device 102, an image sensor 103 and an image stabilizer 104. The lens unit 101 includes the image capturing system disclosed in the 1st embodiment, a barrel and a holder member (their reference numerals are omitted) for holding the image capturing system. However, the lens unit 101 may alternatively be provided with the image capturing system disclosed in other embodiments of the present disclosure, and the present disclosure is not limited thereto. The imaging light converges in the lens unit 101 of the image capturing unit 100 to generate an image with the driving device 102 utilized for image focusing on the image sensor 103, and the generated image is then digitally transmitted to other electronic component for further processing.

[0177] The driving device 102 can have auto focusing functionality, and different driving configurations can be obtained through the usages of voice coil motors (VCM), micro electro-mechanical systems (MEMS), piezoelectric systems, or shape memory alloy materials. The driving device 102 is favorable for obtaining a better imaging position of the lens unit 101, so that a clear image of the imaged object can be captured by the lens unit 101 with different object distances. The image sensor 103 (for example, CCD or CMOS), which can feature high photosensitivity and low noise, is disposed on the image surface of the image capturing system to provide higher image quality.

[0178] The image stabilizer 104, such as an accelerometer, a gyro sensor and a Hall Effect sensor, is configured to work with the driving device 102 to provide optical image stabilization (OIS). The driving device 102 working with the image stabilizer 104 is favorable for compensating for pan and tilt of the lens unit 101 to reduce blurring associated with motion during exposure. In some cases, the compensation can be provided by electronic image stabilization (EIS) with image processing software, thereby improving image quality while in motion or low-light conditions.

10th Embodiment

[0179] Fig. 18 is one perspective view of an electronic device according to the 10th embodiment of the present disclosure. Fig. 19 is another perspective view of the electronic device in Fig. 18. Fig. 20 is a block diagram of the

electronic device in Fig. 18.

[0180] In this embodiment, an electronic device 200 is a smartphone including the image capturing unit 100 disclosed in the 9th embodiment, an image capturing unit 100a, an image capturing unit 100b, an image capturing unit 100c, an image capturing unit 100d, a flash module 201, a focus assist module 202, an image signal processor 203, a display module 204 and an image software processor 205. The image capturing unit 100 and the image capturing unit 100a are disposed on the same side of the electronic device 200 and each of the image capturing units 100 and 100a has a single focal point. The focus assist module 202 can be a laser rangefinder or a ToF (time of flight) module, but the present disclosure is not limited thereto. The image capturing unit 100b, the image capturing unit 100c, the image capturing unit 100d and the display module 204 are disposed on the opposite side of the electronic device 200, and the display module 204 can be a user interface, such that the image capturing units 100b, 100c, 100d can be front-facing cameras of the electronic device 200 for taking selfies, but the present disclosure is not limited thereto. Furthermore, each of the image capturing units 100a, 100b, 100c and 100d can include the image capturing system of the present disclosure and can have a configuration similar to that of the image capturing unit 100. In detail, each of the image capturing units 100a, 100b, 100c and 100d can include a lens unit, a driving device, an image sensor and an image stabilizer, and each of the lens unit can include an optical lens assembly such as the image capturing system of the present disclosure, a barrel and a holder member for holding the optical lens assembly.

[0181] The image capturing unit 100 is a wide-angle image capturing unit, the image capturing unit 100a is an ultra-wide-angle image capturing unit, the image capturing unit 100b is a wide-angle image capturing unit, the image capturing unit 100c is an ultra-wide-angle image capturing unit, and the image capturing unit 100d is a ToF image capturing unit. In this embodiment, the image capturing units 100 and 100a have different fields of view, such that the electronic device 200 can have various magnification ratios so as to meet the requirement of optical zoom functionality. In addition, the image capturing unit 100d can determine depth information of the imaged object. In this embodiment, the electronic device 200 includes multiple image capturing units 100, 100a, 100b, 100c and 100d, but the present disclosure is not limited to the number and arrangement of image capturing units.

[0182] When a user captures images of an object 206, the light rays converge in the image capturing unit 100 or the image capturing unit 100a to generate images, and the flash module 201 is activated for light supplement. The focus assist module 202 detects the object distance of the imaged object 206 to achieve fast auto focusing. The image signal processor 203 is configured to optimize the captured image to improve image quality. The light beam emitted from the focus assist module 202 can be either conventional infrared or laser. In addition, the light rays may converge in the image capturing unit 100b, 100c or 100d to generate images. The display module 204 can include a touch screen, and the user is able to interact with the display module 204 and the image software processor 205 having multiple functions to capture images and complete image processing. Alternatively, the user may capture images via a physical button. The image processed by the image software processor 205 can be displayed on the display module 204.

11th Embodiment

[0183] Fig. 21 is one perspective view of an electronic device according to the 11th embodiment of the present disclosure.

[0184] In this embodiment, an electronic device 300 is a smartphone including the image capturing unit 100 disclosed in the 9th embodiment, an image capturing unit 100e, an image capturing unit 100f, a flash module 301, a focus assist module, an image signal processor, a display module and an image software processor (not shown). The image capturing unit 100, the image capturing unit 100e and the image capturing unit 100f are disposed on the same side of the electronic device 300, while the display module is disposed on the opposite side of the electronic device 300. Furthermore, each of the image capturing units 100e and 100f can include the image capturing system of the present disclosure and can have a configuration similar to that of the image capturing unit 100, and the details in this regard will not be provided again.

[0185] The image capturing unit 100 is a wide-angle image capturing unit, the image capturing unit 100e is a telephoto image capturing unit, and the image capturing unit 100f is an ultra-wide-angle image capturing unit. In this embodiment, the image capturing units 100, 100e and 100f have different fields of view, such that the electronic device 300 can have various magnification ratios so as to meet the requirement of optical zoom functionality. Moreover, the image capturing unit 100e can be a telephoto image capturing unit having a light-folding element configuration, such that the total track length of the image capturing unit 100e is not limited by the thickness of the electronic device 300. Moreover, the light-folding element configuration of the image capturing unit 100e can be similar to, for example, one of the structures shown in Fig. 24 to Fig. 26, which can be referred to foregoing descriptions corresponding to Fig. 24 to Fig. 26, and the details in this regard will not be provided again. In this embodiment, the electronic device 300 includes multiple image capturing units 100, 100e and 100f, but the present disclosure is not limited to the number and arrangement of image capturing units. When a user captures images of an object, light rays converge in the image capturing unit 100, 100e or 100f to generate images, and the flash module 301 is activated for light supplement. Further, the subsequent processes are performed in a manner similar to the abovementioned embodiment, so the details in this regard will not be provided again.

12th Embodiment

[0186]   Fig. 22 is one perspective view of an electronic device according to the 12th embodiment of the present disclosure.

[0187]   In this embodiment, an electronic device 400 is a smartphone including the image capturing unit 100 disclosed in the 9th embodiment, an image capturing unit 100g, an image capturing unit 100h, an image capturing unit 100i, an image capturing unit 100j, an image capturing unit 100k, an image capturing unit 100m, an image capturing unit 100n, an image capturing unit 100p, a flash module 401, a focus assist module, an image signal processor, a display module and an image software processor (not shown). The image capturing units 100, 100g, 100h, 100i, 100j, 100k, 100m, 100n and 100p are disposed on the same side of the electronic device 400, while the display module is disposed on the opposite side of the electronic device 400. Furthermore, each of the image capturing units 100g, 100h, 100i, 100j, 100k, 100m, 100n and 100p can include the image capturing system of the present disclosure and can have a configuration similar to that of the image capturing unit 100, and the details in this regard will not be provided again.

[0188]   The image capturing unit 100 is a wide-angle image capturing unit, the image capturing unit 100g is a telephoto image capturing unit, the image capturing unit 100h is a telephoto image capturing unit, the image capturing unit 100i is a wide-angle image capturing unit, the image capturing unit 100j is an ultra-wide-angle image capturing unit, the image capturing unit 100k is an ultra-wide-angle image capturing unit, the image capturing unit 100m is a telephoto image capturing unit, the image capturing unit 100n is a telephoto image capturing unit, and the image capturing unit 100p is a ToF image capturing unit. In this embodiment, the image capturing units 100, 100g, 100h, 100i, 100j, 100k, 100m and 100n have different fields of view, such that the electronic device 400 can have various magnification ratios so as to meet the requirement of optical zoom functionality. Moreover, each of the image capturing units 100g and 100h can be a telephoto image capturing unit having a light-folding element configuration. Moreover, the light-folding element configuration of each of the image capturing unit 100g and 100h can be similar to, for example, one of the structures shown in Fig. 24 to Fig. 26, which can be referred to foregoing descriptions corresponding to Fig. 24 to Fig. 26, and the details in this regard will not be provided again. In addition, the image capturing unit 100p can determine depth information of the imaged object. In this embodiment, the electronic device 400 includes multiple image capturing units 100, 100g, 100h, 100i, 100j, 100k, 100m, 100n and 100p, but the present disclosure is not limited to the number and arrangement of image capturing units. When a user captures images of an object, the light rays converge in the image capturing unit 100, 100g, 100h, 100i, 100j, 100k, 100m, 100n or 100p to generate images, and the flash module 401 is activated for light supplement. Further, the subsequent processes are performed in a manner similar to the abovementioned embodiments, and the details in this regard will not be provided again.

[0189]   The smartphone in this embodiment is only exemplary for showing the image capturing unit of the present disclosure installed in an electronic device, and the present disclosure is not limited thereto. The image capturing unit can be optionally applied to optical systems with a movable focus. Furthermore, the image capturing system of the image capturing unit features good capability in aberration corrections and high image quality, and can be applied to 3D (three-dimensional) image capturing applications, in products such as digital cameras, mobile devices, digital tablets, smart televisions, network surveillance devices, dashboard cameras, vehicle backup cameras, multi-camera devices, image recognition systems, motion sensing input devices, wearable devices and other electronic imaging devices.

[0190]   The foregoing description, for the purpose of explanation, has been described with reference to specific embodiments. It is to be noted that TABLES 1-16 show different data of the different embodiments; however, the data of the different embodiments are obtained from experiments. The embodiments were chosen and described in order to best explain the principles of the disclosure and its practical applications, to thereby enable others skilled in the art to best utilize the disclosure and various embodiments with various modifications as are suited to the particular use contemplated. The embodiments depicted above and the appended drawings are exemplary and are not intended to be exhaustive or to limit the scope of the present disclosure to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings.

Claims

1. An image capturing system comprising six lens elements (E1-E6), the six lens elements (E1-E6) being, in order from an object side to an image side along an optical path, a first lens element (E1), a second lens element (E2), a third lens element (E3), a fourth lens element (E4), a fifth lens element (E5) and a sixth lens element (E6), and each of the six lens elements (E1-E6) having an object-side surface facing toward the object side and an image-side surface facing toward the image side;

    wherein the image-side surface of the second lens element (E2) is convex in a paraxial region thereof, the fourth lens element (E4) has positive refractive power, the object-side surface of the fourth lens element (E4) is concave

in a paraxial region thereof, the image-side surface of the fourth lens element (E4) is convex in a paraxial region thereof, the object-side surface of the sixth lens element (E6) is convex in a paraxial region thereof, the image-side surface of the sixth lens element (E6) is concave in a paraxial region thereof, and at least one of the object-side surface and the image-side surface of at least one lens element of the image capturing system has at least one inflection point (P) in an off-axis region thereof;

wherein an Abbe number of the fourth lens element (E4) is V4, an Abbe number of the fifth lens element (E5) is V5, a central thickness of the first lens element (E1) is CT1, a central thickness of the second lens element (E2) is CT2, a central thickness of the third lens element (E3) is CT3, a central thickness of the fourth lens element (E4) is CT4, an axial distance between the first lens element (E1) and the second lens element (E2) is T12, an axial distance between the third lens element (E3) and the fourth lens element (E4) is T34, half of a maximum field of view of the image capturing system is HFOV, a curvature radius of the image-side surface of the second lens element (E2) is R4, and the following conditions are satisfied:

$$1.2 < V4/V5 < 7.0;$$

$$3.5 < (CT1+CT2)/T12 < 9.0;$$

$$(CT3+CT4)/T34 < 6.5;$$

$$52.0 \text{ degrees} < HFOV < 80.0 \text{ degrees};$$

and

$$-7.0 < R4/CT2 < -1.6.$$

2. The image capturing system of claim 1, wherein the Abbe number of the fourth lens element (E4) is V4, the Abbe number of the fifth lens element (E5) is V5, half of the maximum field of view of the image capturing system is HFOV, and the following conditions are satisfied:

$$1.7 < V4/V5 < 6.0;$$

and

$$54.5 \text{ degrees} < HFOV < 70.0 \text{ degrees}.$$

3. The image capturing system of claim 1, wherein the central thickness of the first lens element (E1) is CT1, the central thickness of the second lens element (E2) is CT2, the axial distance between the first lens element (E1) and the second lens element (E2) is T12, and the following condition is satisfied:

$$4.0 < (CT1+CT2)/T12 < 7.0.$$

4. The image capturing system of claim 1, wherein the central thickness of the second lens element (E2) is CT2, the central thickness of the third lens element (E3) is CT3, the central thickness of the fourth lens element (E4) is CT4, the axial distance between the third lens element (E3) and the fourth lens element (E4) is T34, the curvature radius of the image-side surface of the second lens element (E2) is R4, and the following conditions are satisfied:

$$1.0 < (CT3+CT4)/T34 < 6.0;$$

and

$$-6.0 < R4/CT2 < -1.9.$$

5. The image capturing system of claim 1, wherein an Abbe number of the second lens element (E2) is V2, an Abbe number of the third lens element (E3) is V3, the Abbe number of the fourth lens element (E4) is V4, the Abbe number of the fifth lens element (E5) is V5, and the following condition is satisfied:

$$2.8 < (V2+V4)/(V3+V5) < 6.0.$$

6. The image capturing system of claim 1, wherein an axial distance between the object-side surface of the first lens element (E1) and an image surface (IMG) is TL, a maximum image height of the image capturing system is ImgH, an entrance pupil diameter of the image capturing system is EPD, a maximum effective radius of the object-side surface of the first lens element (E1) is Y11, and the following conditions are satisfied:

$$1.0 < TL/ImgH < 2.0;$$

and

$$1.8 < EPD/Y11 < 2.2.$$

7. The image capturing system of claim 1, wherein a curvature radius of the object-side surface of the sixth lens element (E6) is R11, a curvature radius of the image-side surface of the sixth lens element (E6) is R12, a focal length of the image capturing system is f, a focal length of the fifth lens element (E5) is f5, a focal length of the sixth lens element (E6) is f6, and the following conditions are satisfied:

$$2.0 < (R11+R12)/(R11-R12);$$

and

$$-2.0 < f/f5+f/f6 < 0.$$

8. The image capturing system of claim 1, wherein a curvature radius of the object-side surface of the fifth lens element (E5) is R9, a curvature radius of the image-side surface of the fifth lens element (E5) is R10, a curvature radius of the object-side surface of the sixth lens element (E6) is R11, a curvature radius of the image-side surface of the sixth lens element (E6) is R12, and the following condition is satisfied:

$$|R11/R9|+|R12/R10| < 0.50.$$

9. The image capturing system of claim 1, wherein a vertical distance between a non-axial concave critical point (C) on the object-side surface of the sixth lens element (E6) and an optical axis is Yc61, a vertical distance between a non-axial convex critical point (C) on the image-side surface of the sixth lens element (E6) and the optical axis is Yc62, the object-side surface of the sixth lens element (E6) has at least one concave critical point (C) in an off-axis region thereof and the image-side surface of the sixth lens element (E6) has at least one convex critical point (C) in an off-axis region thereof satisfying the following condition:

$$1.0 < Yc62/Yc61 < 2.0.$$

10. An image capturing system comprising six lens elements (E1-E6), the six lens elements (E1-E6) being, in order from an object side to an image side along an optical path, a first lens element (E1), a second lens element (E2), a third lens element (E3), a fourth lens element (E4), a fifth lens element (E5) and a sixth lens element (E6), and each of the six lens elements (E1-E6) having an object-side surface facing toward the object side and an image-side

surface facing toward the image side;

wherein the second lens element (E2) has positive refractive power, the image-side surface of the second lens element (E2) is convex in a paraxial region thereof, the fourth lens element (E4) has positive refractive power, the object-side surface of the fourth lens element (E4) is concave in a paraxial region thereof, the image-side surface of the fourth lens element (E4) is convex in a paraxial region thereof, the image-side surface of the sixth lens element (E6) is concave in a paraxial region thereof, and at least one of the object-side surface and the image-side surface of at least one lens element of the image capturing system has at least one inflection point (P) in an off-axis region thereof;

wherein an Abbe number of the fourth lens element (E4) is V4, an Abbe number of the fifth lens element (E5) is V5, a central thickness of the first lens element (E1) is CT1, a central thickness of the second lens element (E2) is CT2, a central thickness of the third lens element (E3) is CT3, a central thickness of the fourth lens element (E4) is CT4, an axial distance between the first lens element (E1) and the second lens element (E2) is T12, an axial distance between the third lens element (E3) and the fourth lens element (E4) is T34, half of a maximum field of view of the image capturing system is HFOV, a focal length of the image capturing system is f, a curvature radius of the object-side surface of the first lens element (E1) is R1, a curvature radius of the image-side surface of the first lens element (E1) is R2, and the following conditions are satisfied:

$$1.2 < V4/V5 < 7.0;$$

$$2.5 < (CT1+CT2)/T12 < 9.0;$$

$$(CT3+CT4)/T34 < 5.5;$$

$$52.0 \text{ degrees} < HFOV < 80.0 \text{ degrees};$$

and

$$|f/R1|+|f/R2| < 1.5.$$

11. The image capturing system of claim 10, wherein the Abbe number of the fourth lens element (E4) is V4, the Abbe number of the fifth lens element (E5) is V5, and the following condition is satisfied:

$$1.7 < V4/V5 < 6.0;$$

wherein an Abbe number of the first lens element (E1) is V1, an Abbe number of the second lens element (E2) is V2, an Abbe number of the third lens element (E3) is V3, an Abbe number of the sixth lens element (E6) is V6, an Abbe number of the i-th lens element is Vi, a refractive index of the first lens element (E1) is N1, a refractive index of the second lens element (E2) is N2, a refractive index of the third lens element (E3) is N3, a refractive index of the fourth lens element (E4) is N4, a refractive index of the fifth lens element (E5) is N5, a refractive index of the sixth lens element (E6) is N6, a refractive index of the i-th lens element is Ni, and at least one lens element of the image capturing system satisfies the following condition:
$5.0 < Vi/Ni < 11$, wherein i = 1, 2, 3, 4, 5 or 6.

12. The image capturing system of claim 10, wherein the central thickness of the first lens element (E1) is CT1, the central thickness of the second lens element (E2) is CT2, the axial distance between the first lens element (E1) and the second lens element (E2) is T12, the focal length of the image capturing system is f, the curvature radius of the object-side surface of the first lens element (E1) is R1, the curvature radius of the image-side surface of the first lens element (E1) is R2, and the following conditions are satisfied:

$$3.0 < (CT1+CT2)/T12 < 8.0;$$

and

$$|f/R1|+|f/R2| < 0.90.$$

13. The image capturing system of claim 10, wherein the central thickness of the third lens element (E3) is CT3, the central thickness of the fourth lens element (E4) is CT4, a central thickness of the fifth lens element (E5) is CT5, a central thickness of the sixth lens element (E6) is CT6, the axial distance between the third lens element (E3) and the fourth lens element (E4) is T34, an axial distance between the fourth lens element (E4) and the fifth lens element (E5) is T45, an axial distance between the fifth lens element (E5) and the sixth lens element (E6) is T56, and the following conditions are satisfied:

$$1.7 < (CT3+CT4)/T34 < 5.0;$$

and

$$3.3 < (CT4+CT5+CT6)/(T45+T56) < 50.$$

14. The image capturing system of claim 10, wherein half of the maximum field of view of the image capturing system is HFOV, an f-number of the image capturing system is Fno, and the following conditions are satisfied:

$$54.5 \text{ degrees} < HFOV < 70.0 \text{ degrees};$$

and

$$1.4 < Fno < 2.4.$$

15. The image capturing system of claim 10, wherein half of the maximum field of view of the image capturing system is HFOV, a maximum effective radius of the object-side surface of the first lens element (E1) is Y11, a maximum effective radius of the image-side surface of the sixth lens element (E6) is Y62, and the following condition is satisfied:

$$5.0 < \tan(HFOV) \times Y62/Y11.$$

16. The image capturing system of claim 10, wherein a curvature radius of the object-side surface of the fourth lens element (E4) is R7, a focal length of the fourth lens element (E4) is f4, and the following condition is satisfied:

$$-1.3 < R7/f4 < -0.40.$$

17. The image capturing system of claim 10, wherein a vertical distance between a non-axial concave critical point (C) on the object-side surface of the fifth lens element (E5) and an optical axis is Yc51, a vertical distance between a non-axial convex critical point (C) on the image-side surface of the fifth lens element (E5) and the optical axis is Yc52, the object-side surface of the fifth lens element (E5) has at least one concave critical point (C) in an off-axis region thereof and the image-side surface of the fifth lens element (E5) has at least one convex critical point (C) in an off-axis region thereof satisfying the following condition:

$$0.70 < Yc52/Yc51 < 1.4.$$

18. An image capturing unit (100), comprising:

the image capturing system of claim 10; and
an image sensor (103) disposed on an image surface (IMG) of the image capturing system.

19. An electronic device (200), comprising:
the image capturing unit (100) of claim 18.

20. An image capturing system comprising six lens elements (E1-E6), the six lens elements (E1-E6) being, in order from an object side to an image side along an optical path, a first lens element (E1), a second lens element (E2), a third lens element (E3), a fourth lens element (E4), a fifth lens element (E5) and a sixth lens element (E6), and each of the six lens elements (E1-E6) having an object-side surface facing toward the object side and an image-side surface facing toward the image side;

wherein the second lens element (E2) has positive refractive power, the fourth lens element (E4) has positive refractive power, the object-side surface of the fourth lens element (E4) is concave in a paraxial region thereof, the image-side surface of the fourth lens element (E4) is convex in a paraxial region thereof, the object-side surface of the sixth lens element (E6) is convex in a paraxial region thereof, and at least one of the object-side surface and the image-side surface of at least one lens element of the image capturing system has at least one inflection point (P) in an off-axis region thereof;
wherein an Abbe number of the fourth lens element (E4) is V4, an Abbe number of the fifth lens element (E5) is V5, a central thickness of the first lens element (E1) is CT1, a central thickness of the second lens element (E2) is CT2, a central thickness of the third lens element (E3) is CT3, a central thickness of the fourth lens element (E4) is CT4, an axial distance between the first lens element (E1) and the second lens element (E2) is T12, an axial distance between the third lens element (E3) and the fourth lens element (E4) is T34, half of a maximum field of view of the image capturing system is HFOV, a focal length of the image capturing system is f, a curvature radius of the object-side surface of the first lens element (E1) is R1, and the following conditions are satisfied:

$$1.2 < V4/V5 < 7.0;$$

$$3.5 < (CT1+CT2)/T12 < 9.0;$$

$$(CT3+CT4)/T34 < 5.0;$$

$$52.0 \text{ degrees} < HFOV < 80.0 \text{ degrees};$$

and

$$|f/R1| < 0.90.$$

21. The image capturing system of claim 20, wherein the Abbe number of the fourth lens element (E4) is V4, the Abbe number of the fifth lens element (E5) is V5, and the following condition is satisfied:

$$1.7 < V4/V5 < 6.0.$$

22. The image capturing system of claim 20, wherein the central thickness of the first lens element (E1) is CT1, the central thickness of the second lens element (E2) is CT2, the axial distance between the first lens element (E1) and the second lens element (E2) is T12, and the following condition is satisfied:

$$4.0 < (CT1+CT2)/T12 < 7.0.$$

23. The image capturing system of claim 20, wherein the central thickness of the third lens element (E3) is CT3, the central thickness of the fourth lens element (E4) is CT4, the axial distance between the third lens element (E3) and the fourth lens element (E4) is T34, the Abbe number of the fifth lens element (E5) is V5, an Abbe number of the sixth lens element (E6) is V6, and the following conditions are satisfied:

$$2.0 < (CT3+CT4)/T34 < 4.5;$$

and

$$20.0 < V5+V6 < 65.0.$$

24. The image capturing system of claim 20, wherein half of the maximum field of view of the image capturing system is HFOV, the focal length of the image capturing system is f, the curvature radius of the object-side surface of the first lens element (E1) is R1, and the following conditions are satisfied:

$$54.5 \text{ degrees} < HFOV < 70.0 \text{ degrees};$$

and

$$|f/R1| < 0.75.$$

25. The image capturing system of claim 24, further comprising an aperture stop (ST), wherein a maximum effective radius of the object-side surface of the first lens element (E1) is Y11, a maximum effective radius of the image-side surface of the sixth lens element (E6) is Y62, an aperture radius of the aperture stop (ST) is YS, and the following conditions are satisfied:

$$3.4 < Y62/Y11 < 5.0;$$

and

$$0.90 < YS/Y11 < 1.1.$$

26. The image capturing system of claim 20, wherein a focal length of the first lens element (E1) is f1, a focal length of the second lens element (E2) is f2, a focal length of the third lens element (E3) is f3, and the following condition is satisfied:

$$|f2/f1|+|f2/f3| < 1.0.$$

27. The image capturing system of claim 20, wherein at least one of the object-side surface and the image-side surface of each of at least two lens elements of the image capturing system has at least one inflection point (P) in an off-axis region thereof;
wherein a curvature radius of the object-side surface of the fourth lens element (E4) is R7, a curvature radius of the image-side surface of the fourth lens element (E4) is R8, and the following condition is satisfied:

$$1.0 < (R7+R8)/(R7-R8) < 6.0.$$

FIG. 1

LONGITUDINAL
SPHERICAL ABER.

ASTIGMATIC
FIELD CURVES
IMG HT

DISTORTION
IMG HT

656.3000 NM
587.6000 NM
486.1000 NM

T
S

FOCUS (MILLIMETERS)

FOCUS (MILLIMETERS)

% DISTORTION
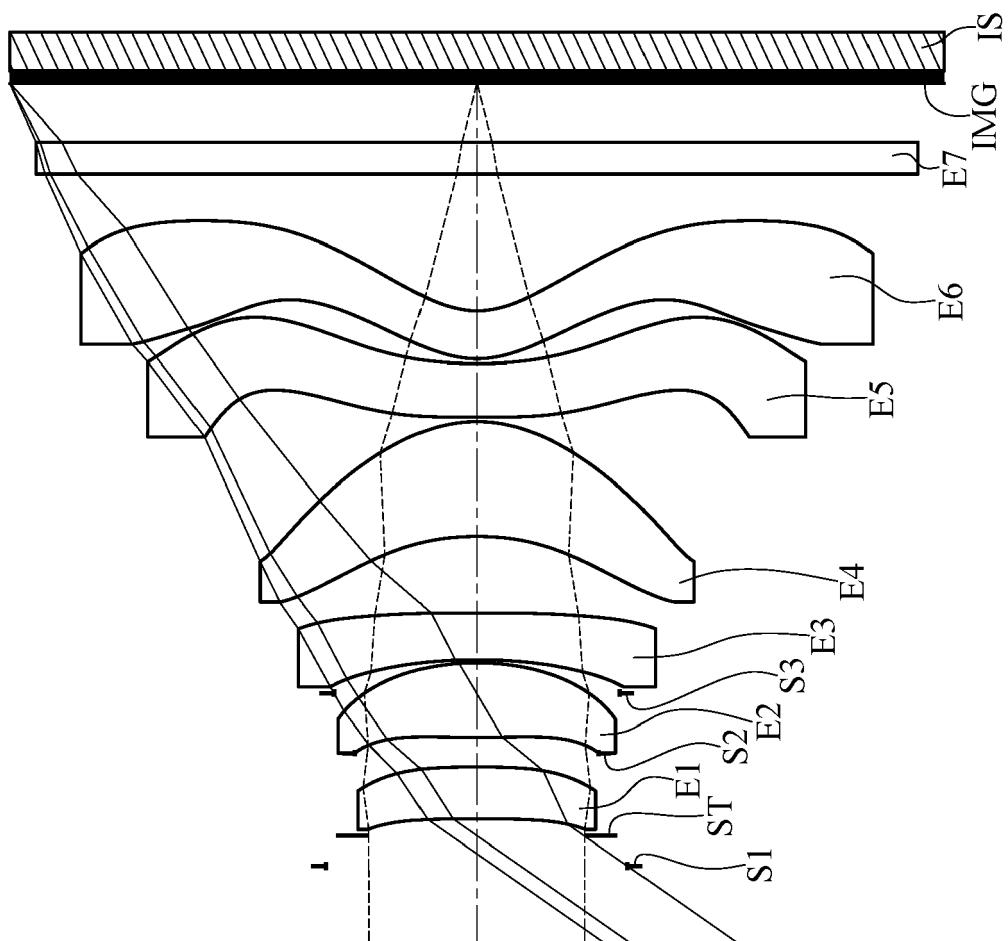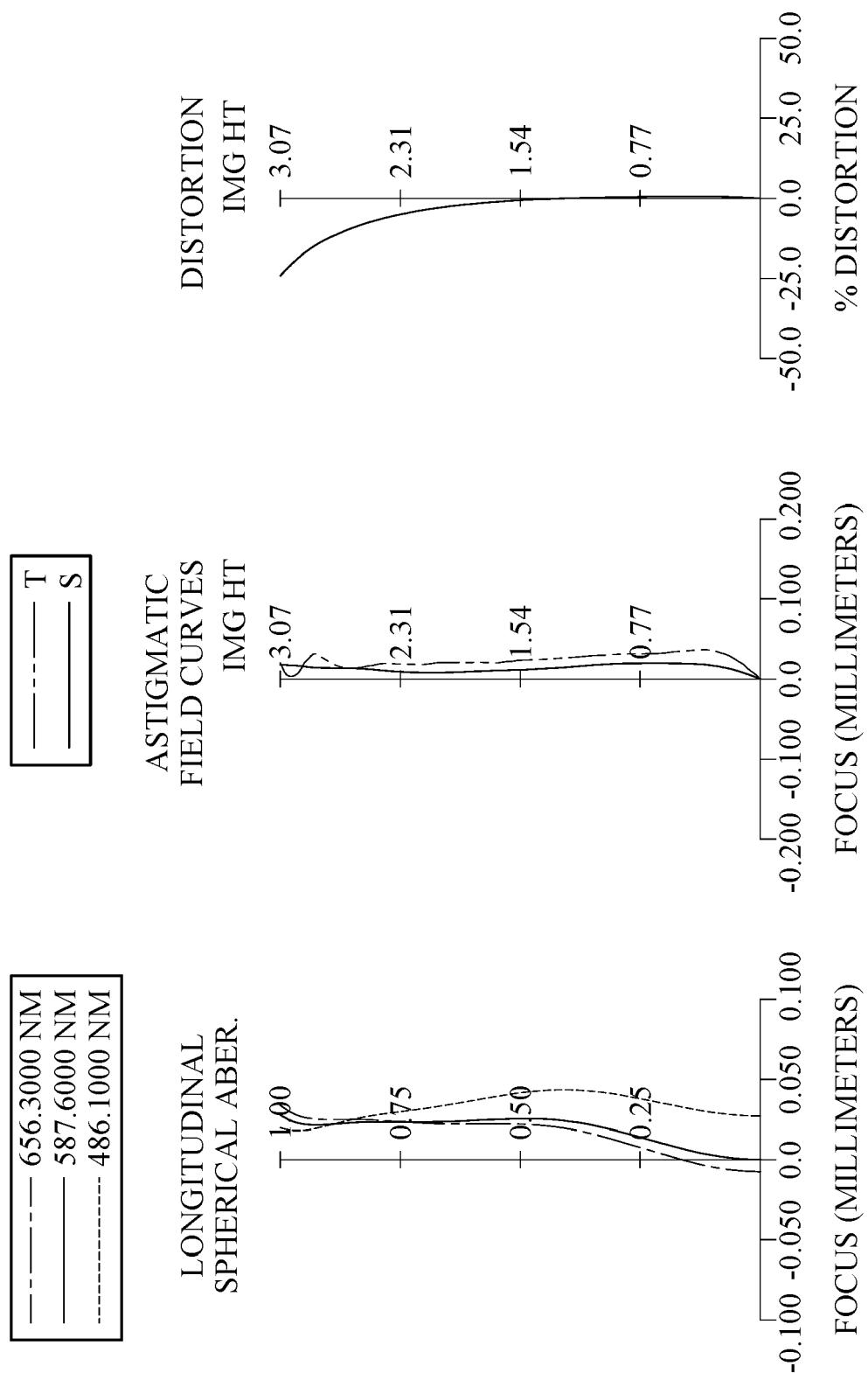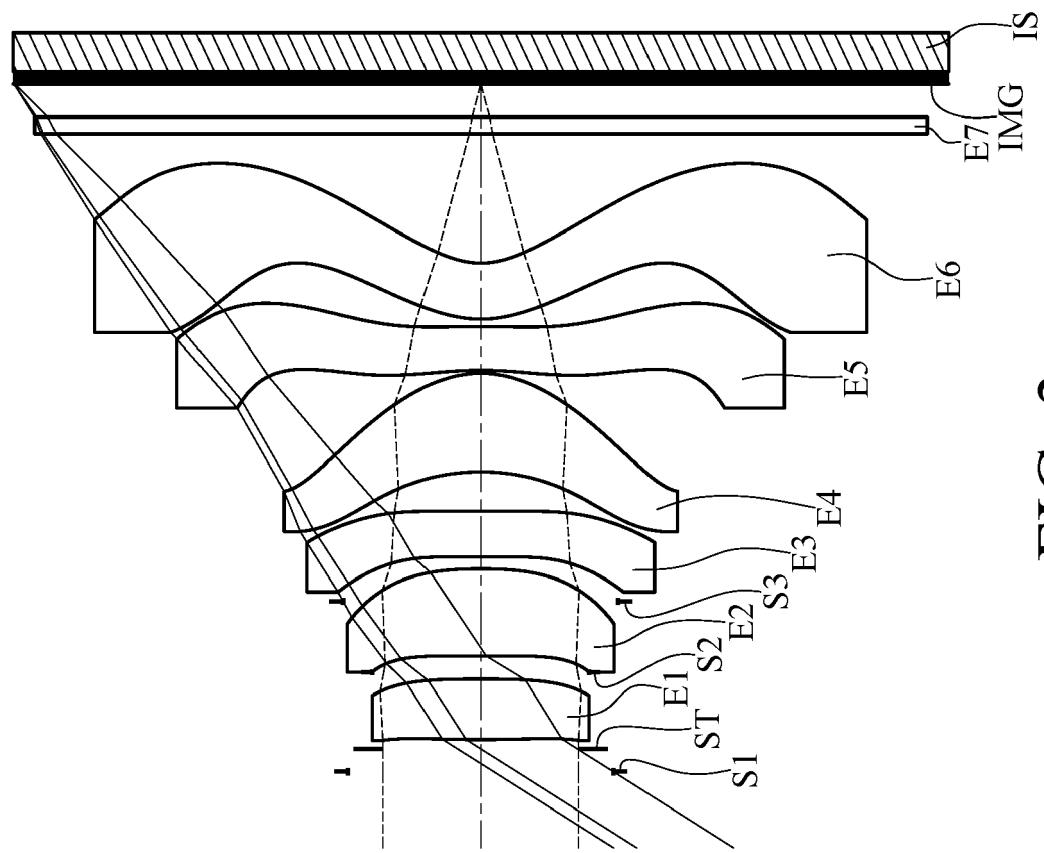
FIG. 2

FIG. 3
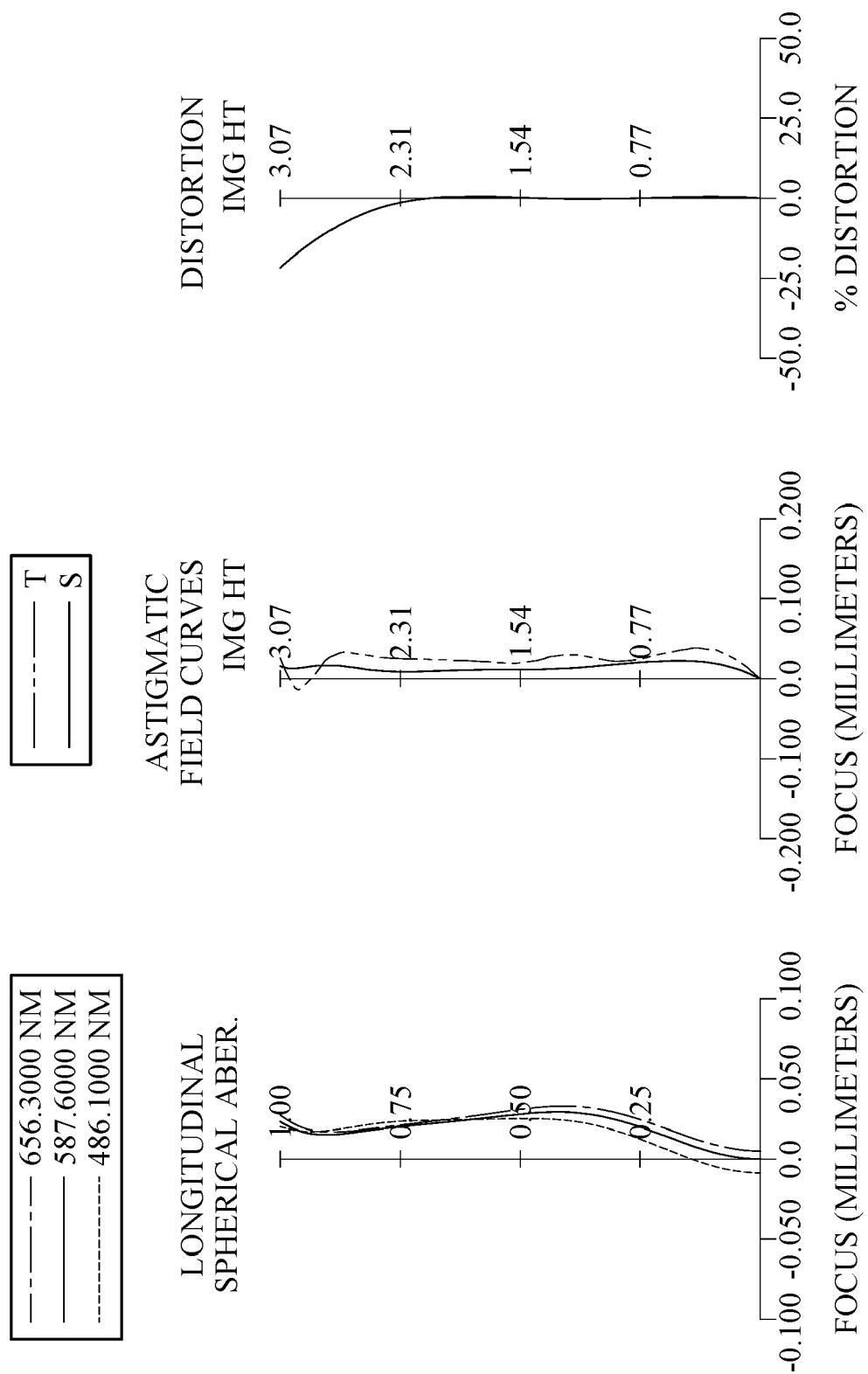
FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

FIG. 9

LONGITUDINAL
SPHERICAL ABER.

656.3000 NM
587.6000 NM
486.1000 NM

ASTIGMATIC
FIELD CURVES
IMG HT

T
S

DISTORTION
IMG HT

FOCUS (MILLIMETERS)

FOCUS (MILLIMETERS)

% DISTORTION

FIG. 10

FIG. 11

LONGITUDINAL SPHERICAL ABER.

ASTIGMATIC FIELD CURVES

DISTORTION

FIG. 12

FIG. 13

FIG. 14
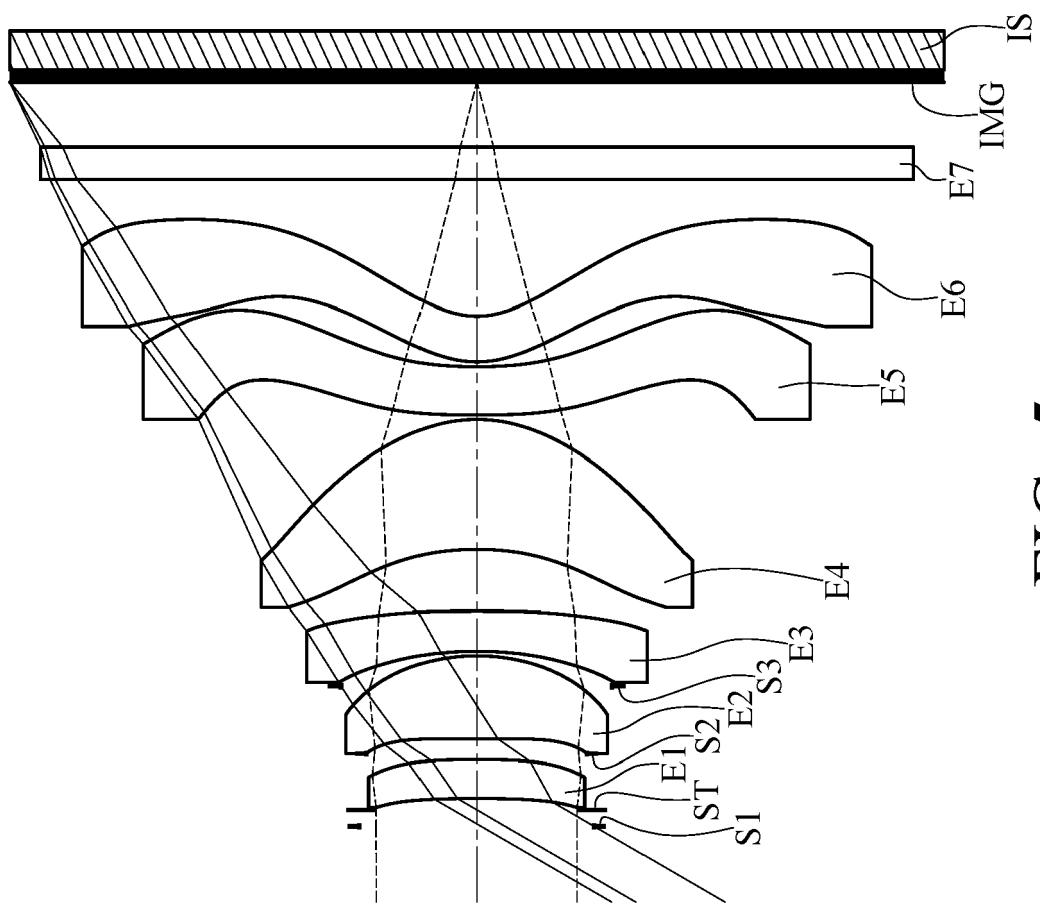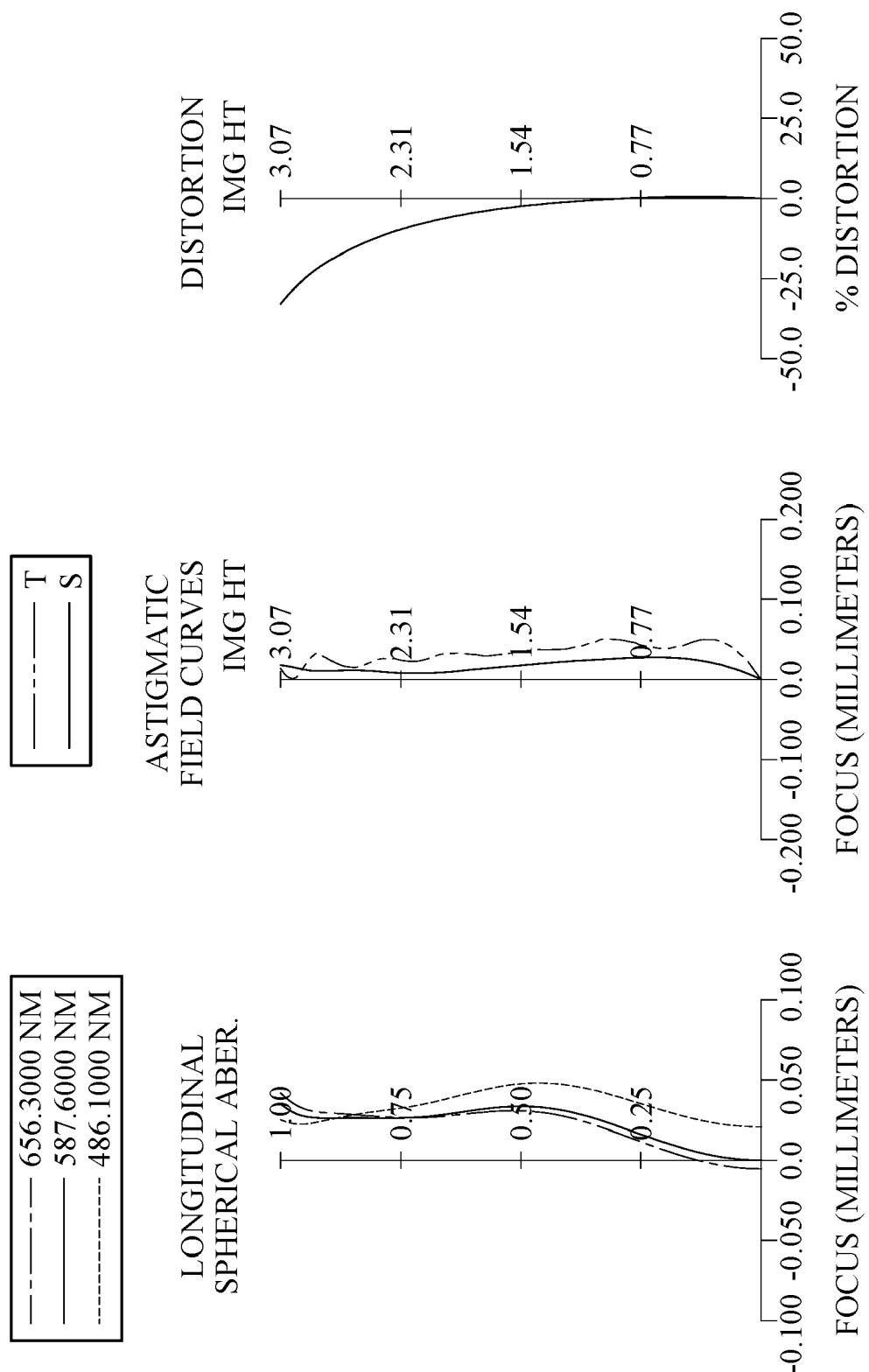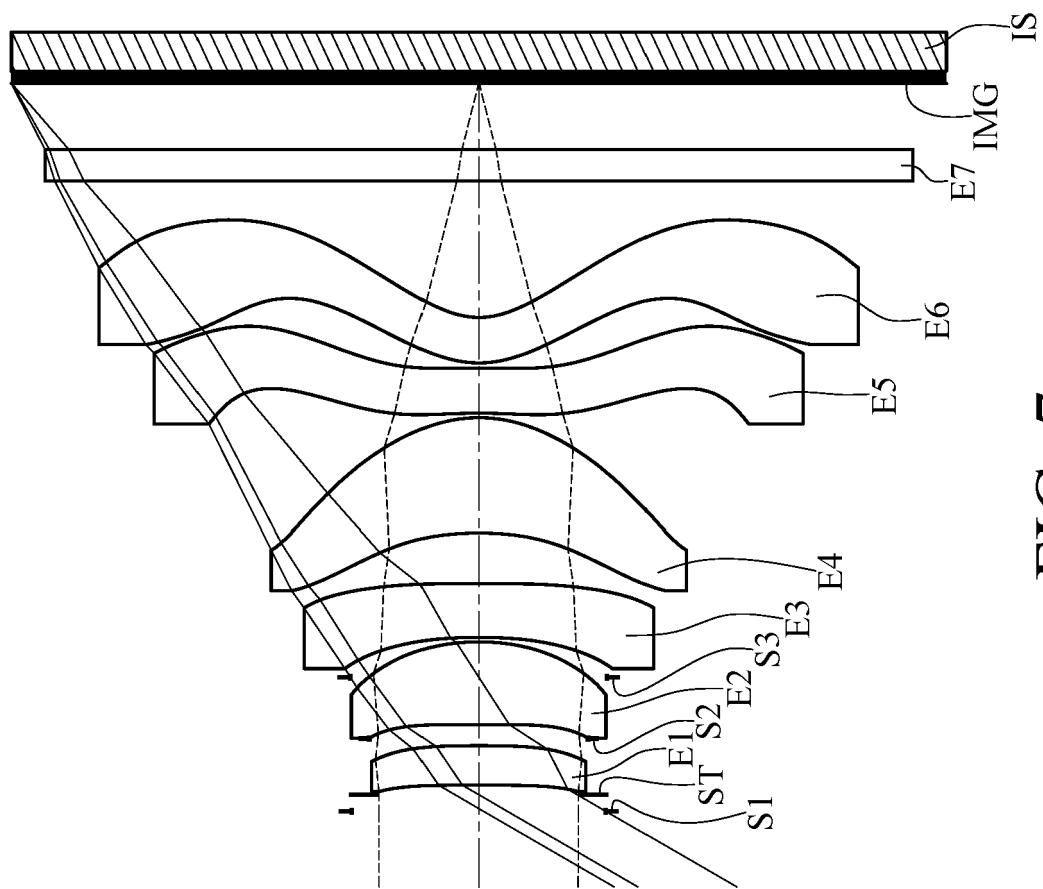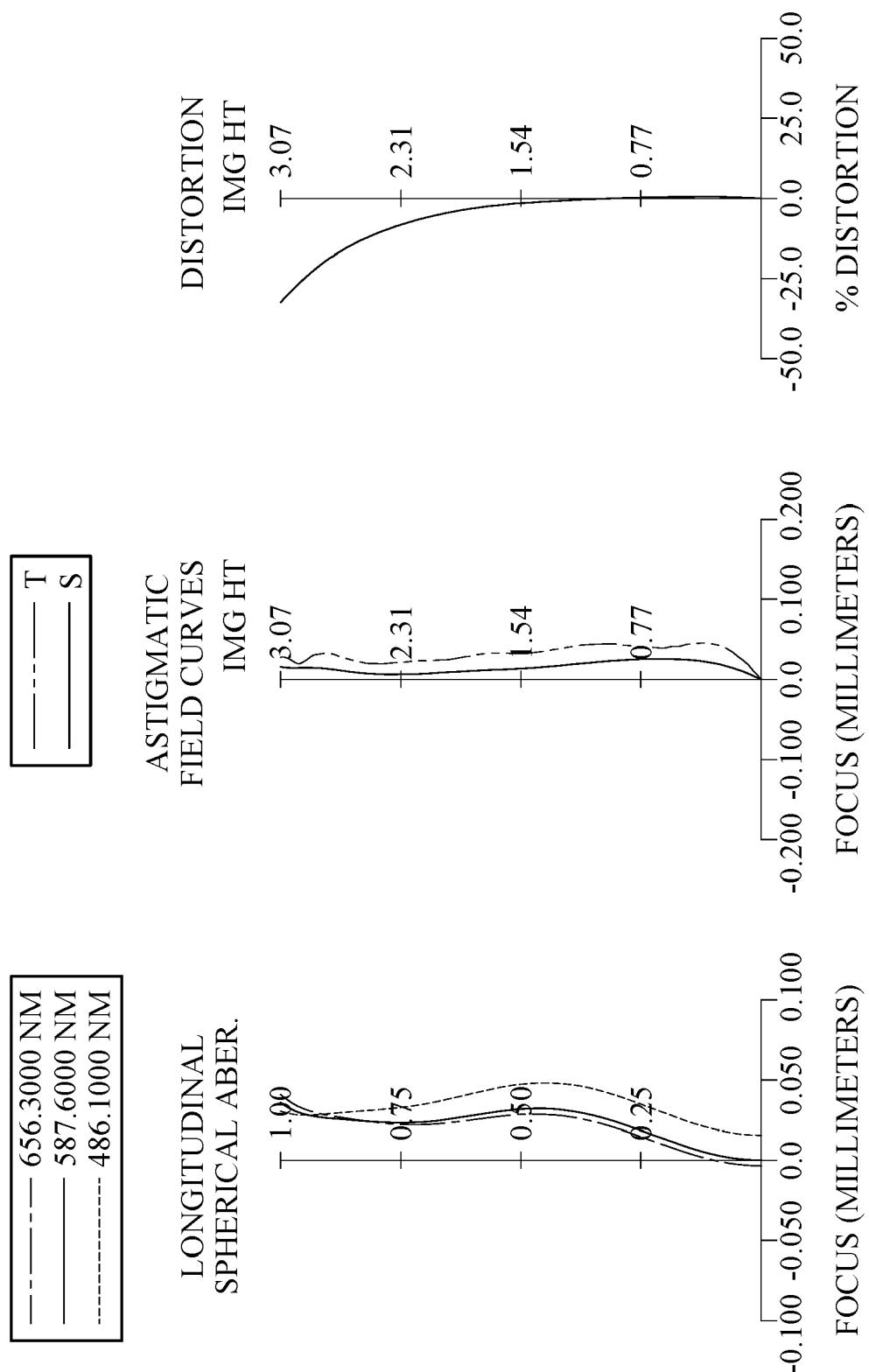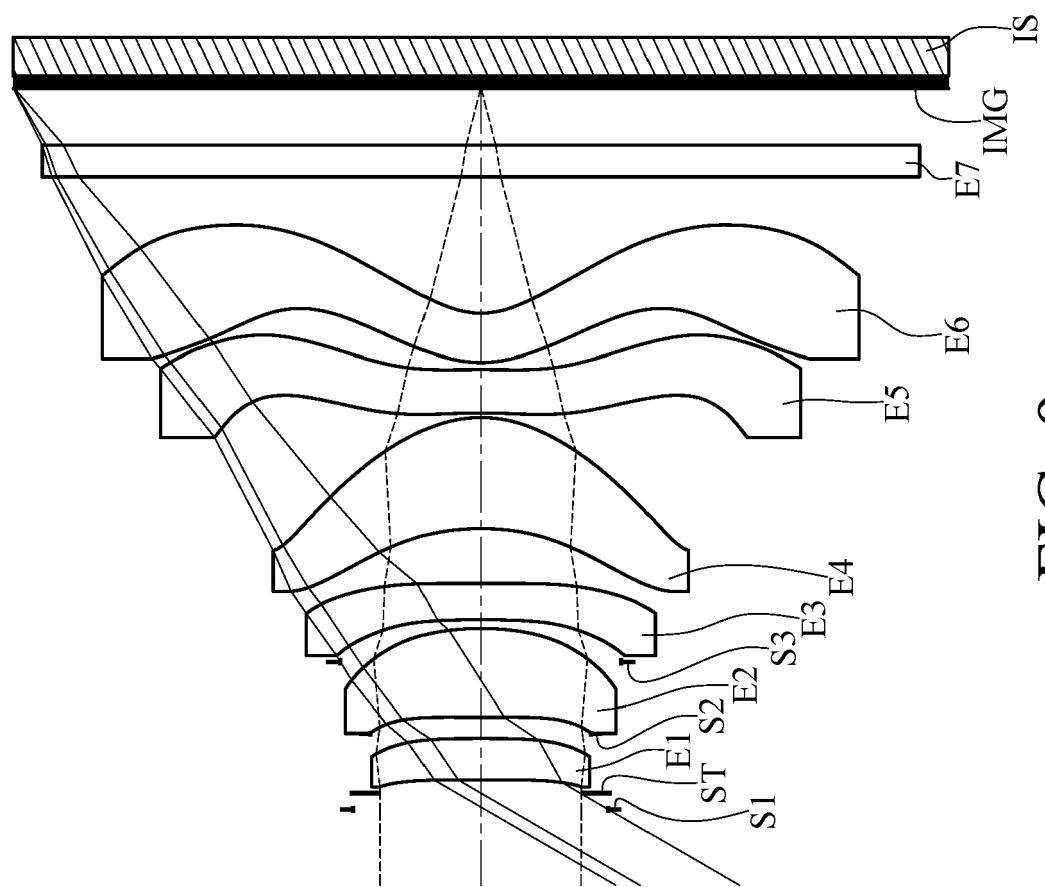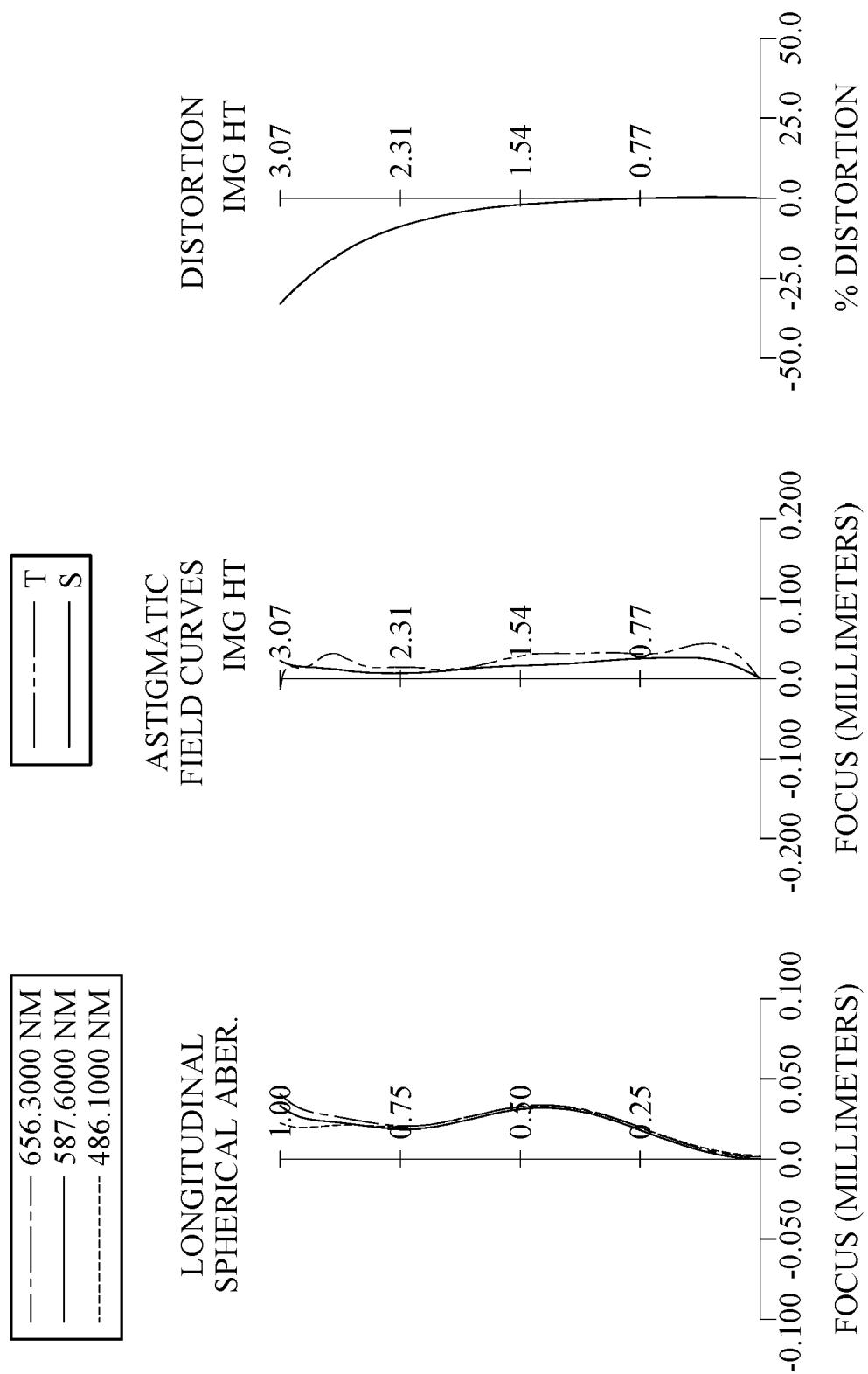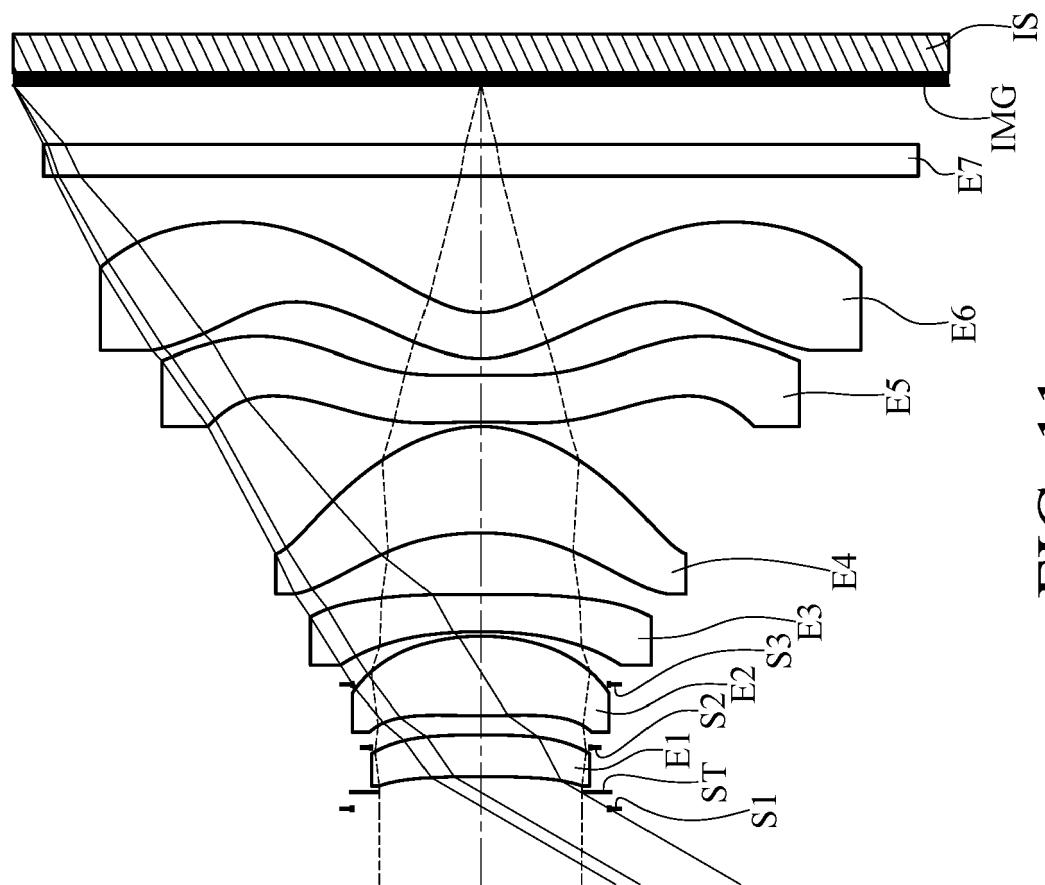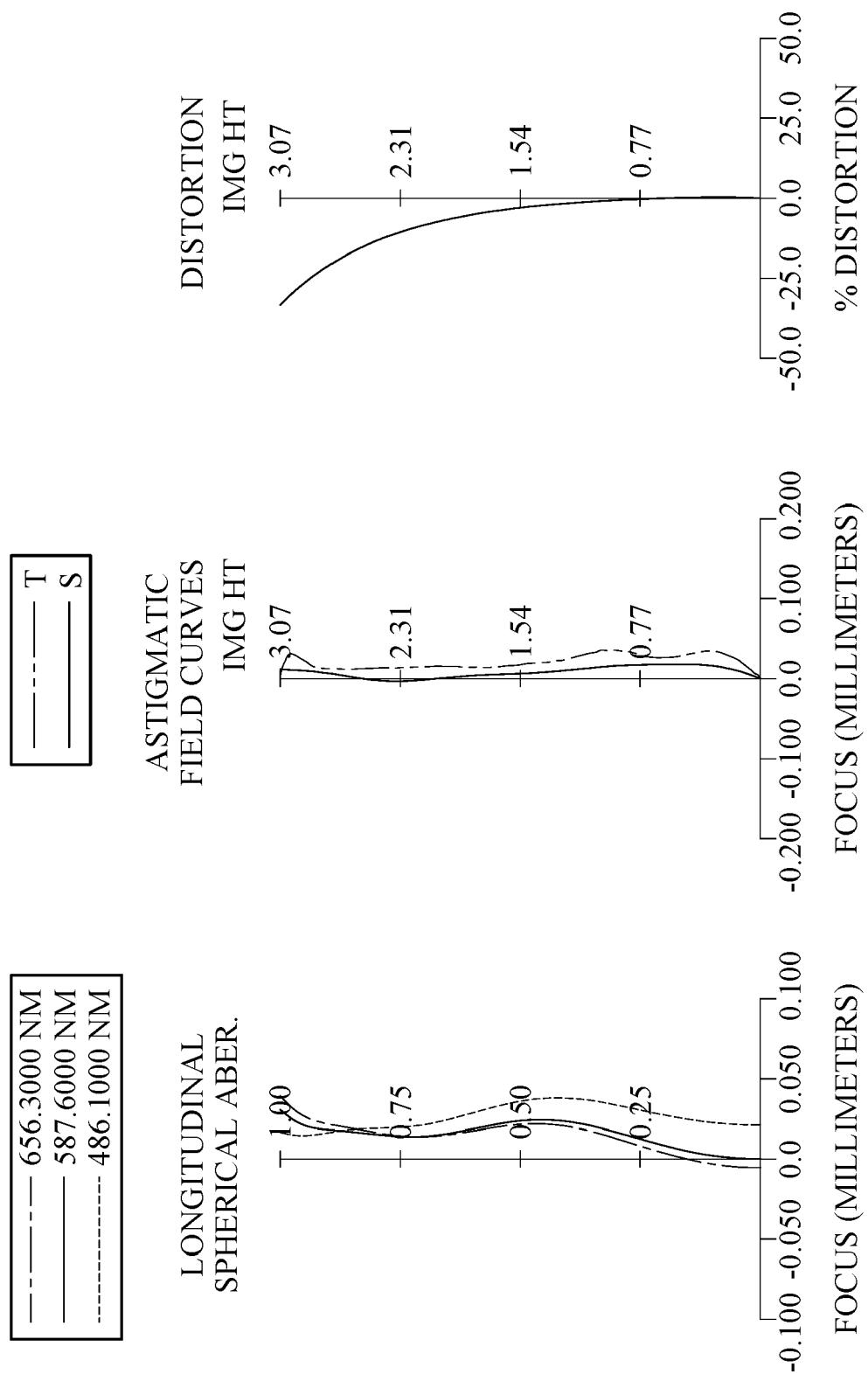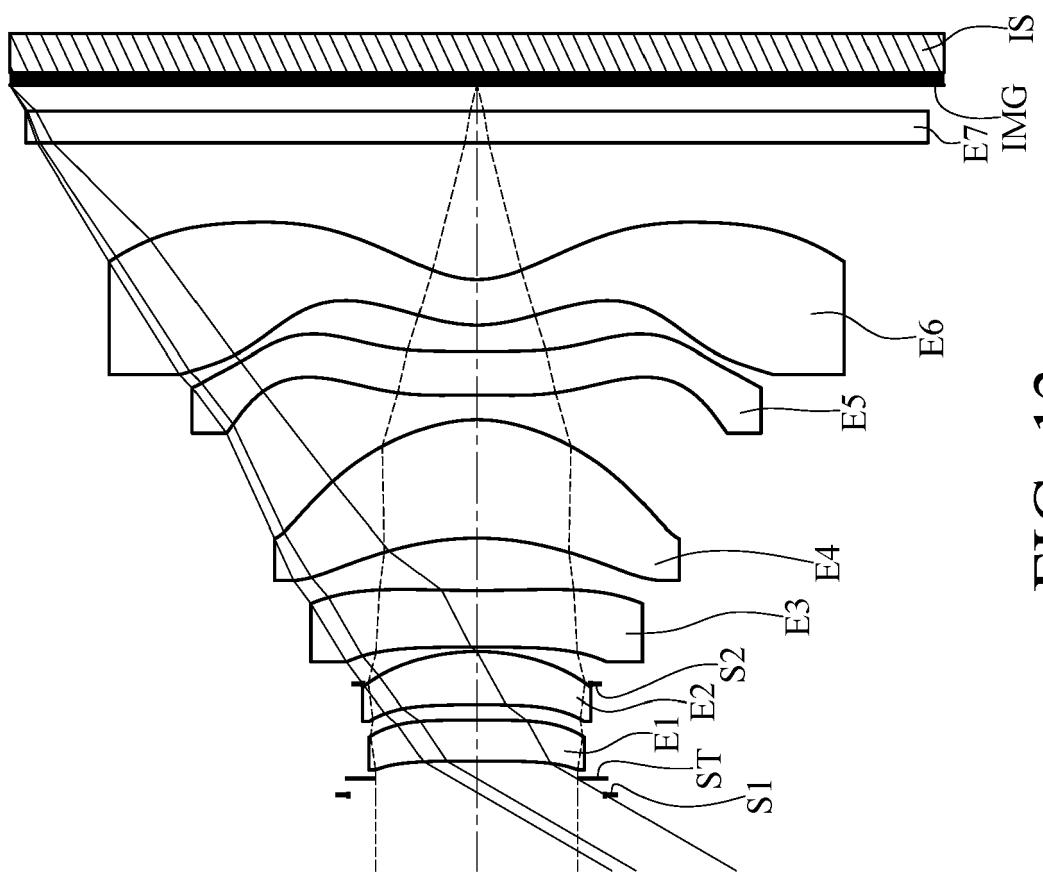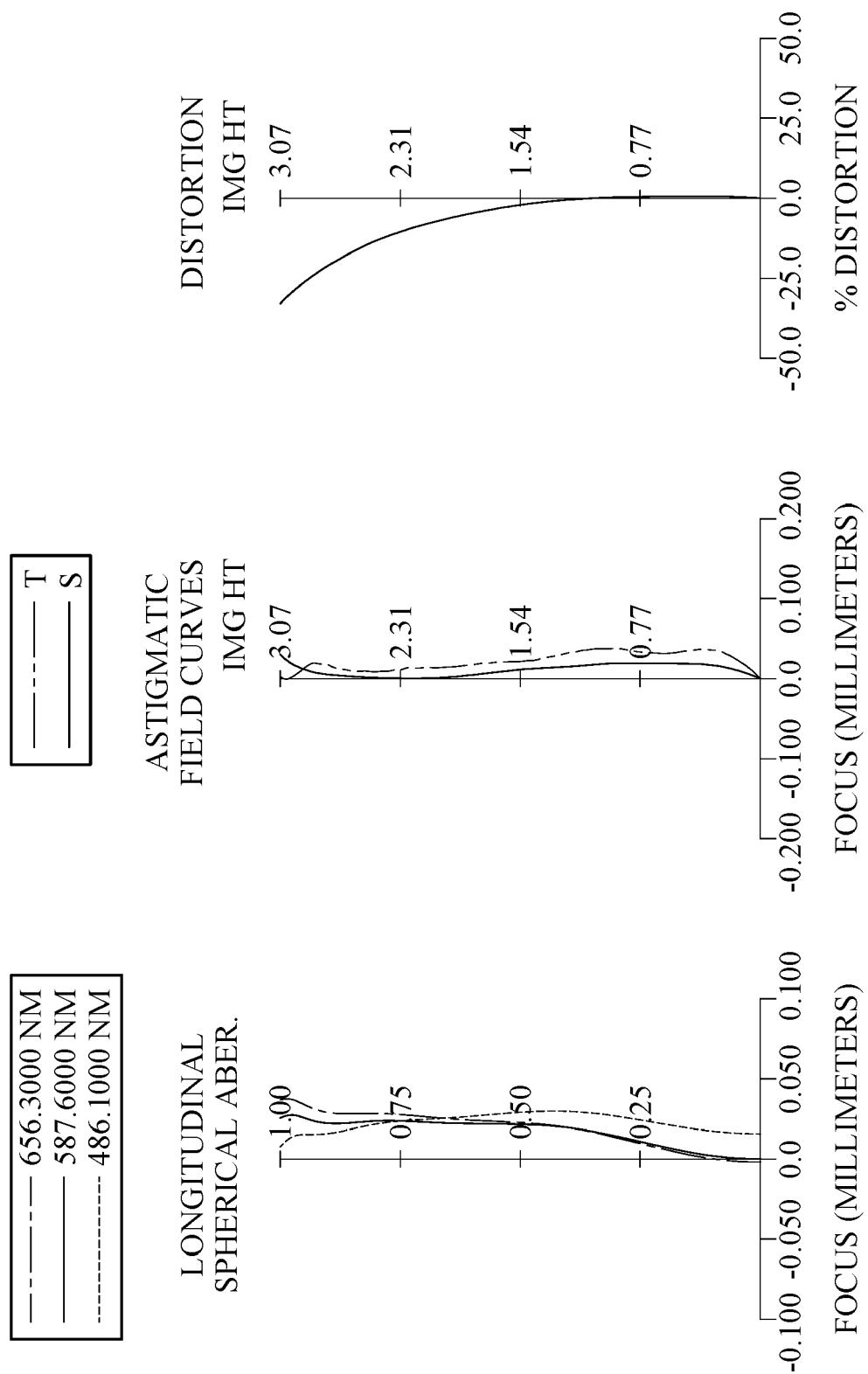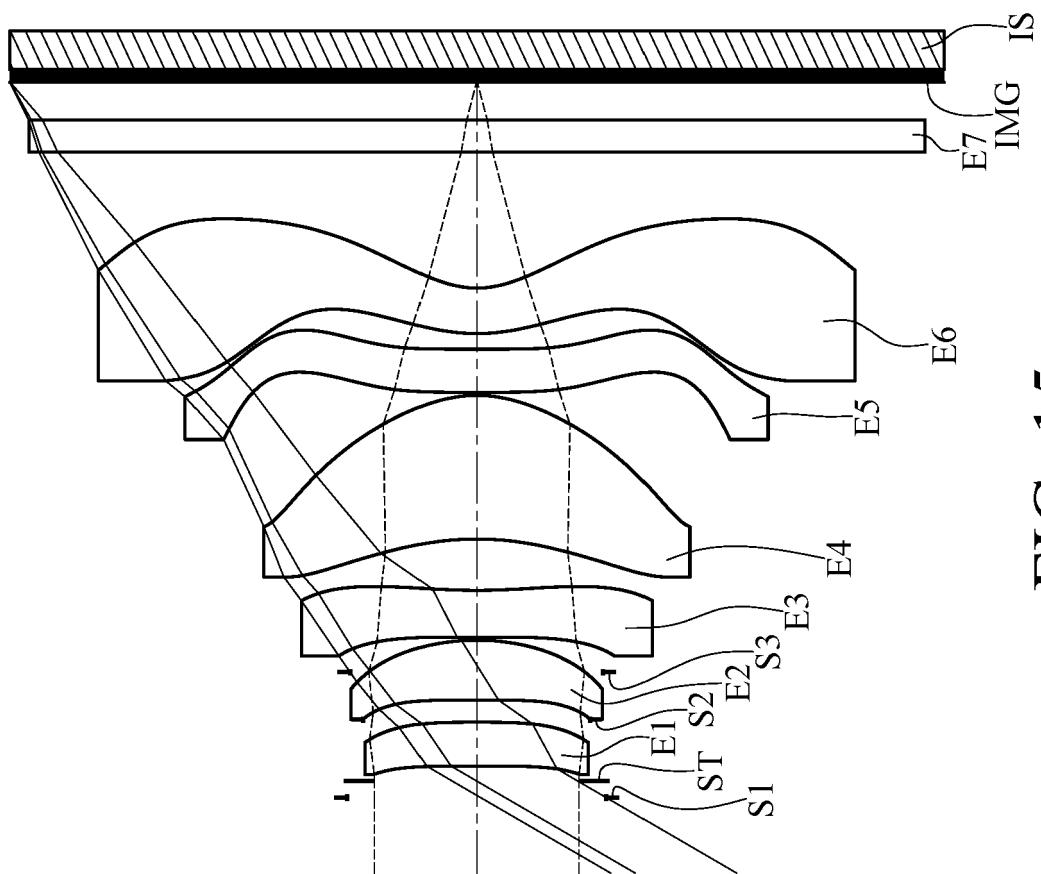
FIG. 15
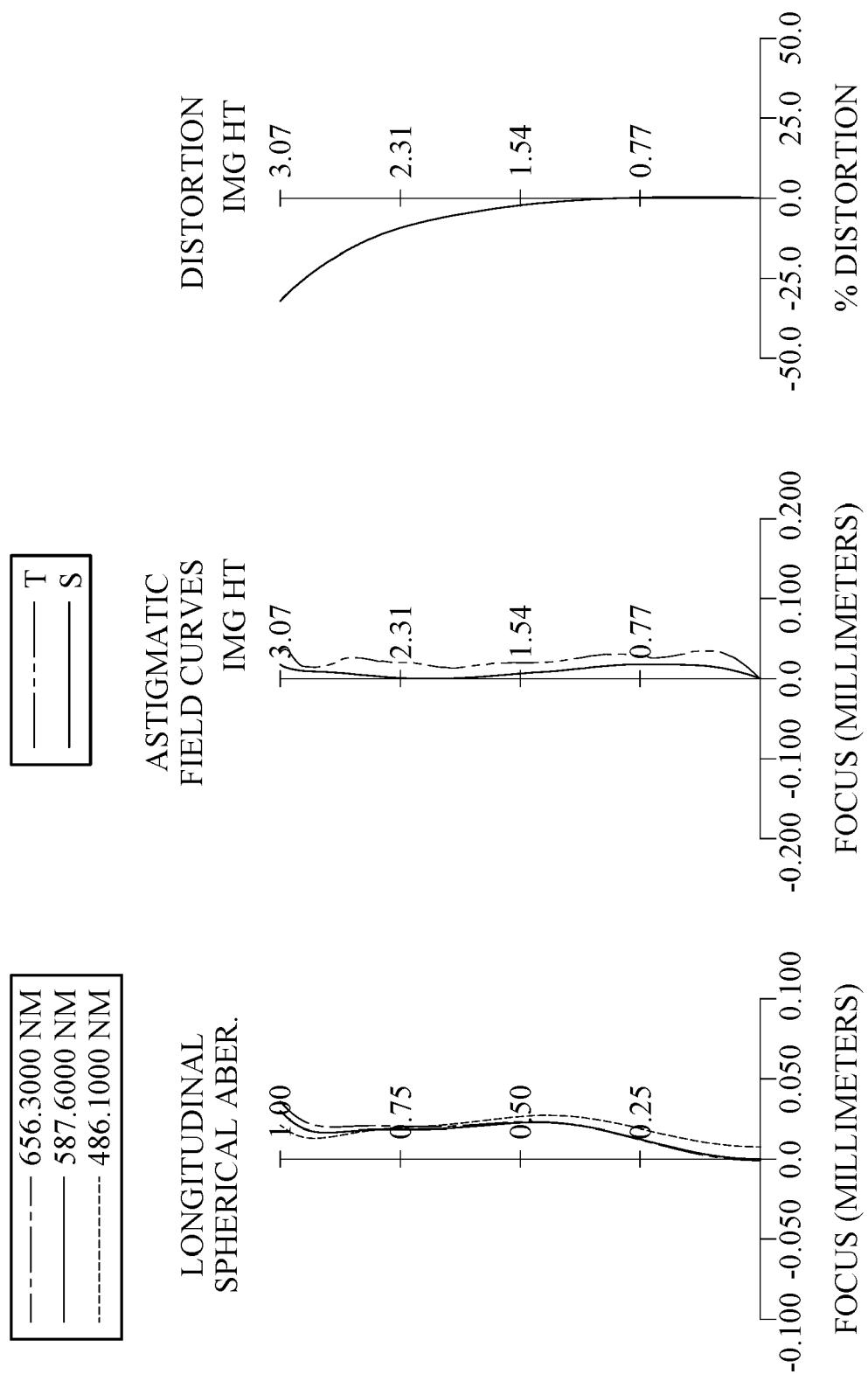
FIG. 16
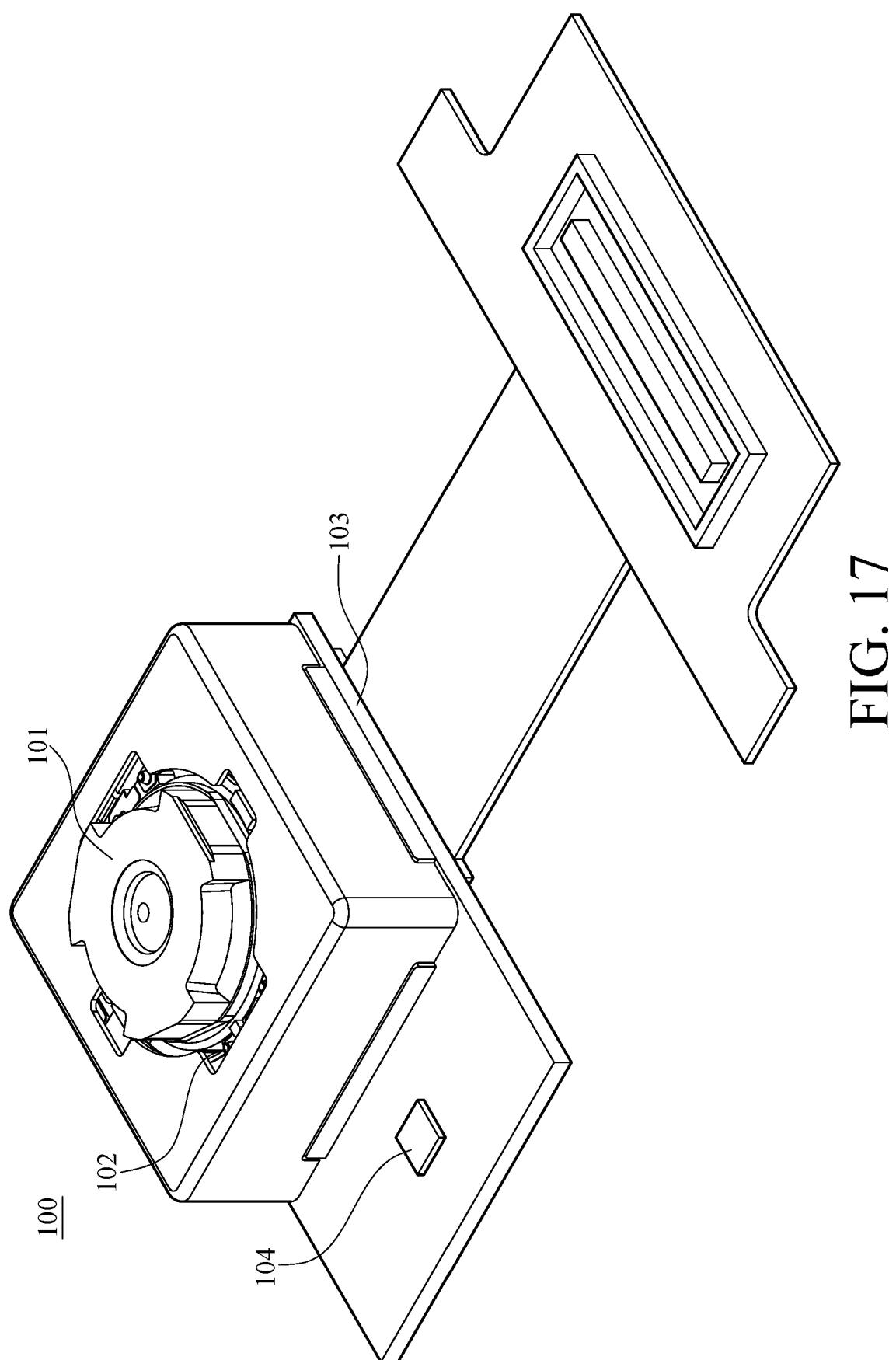
FIG. 17
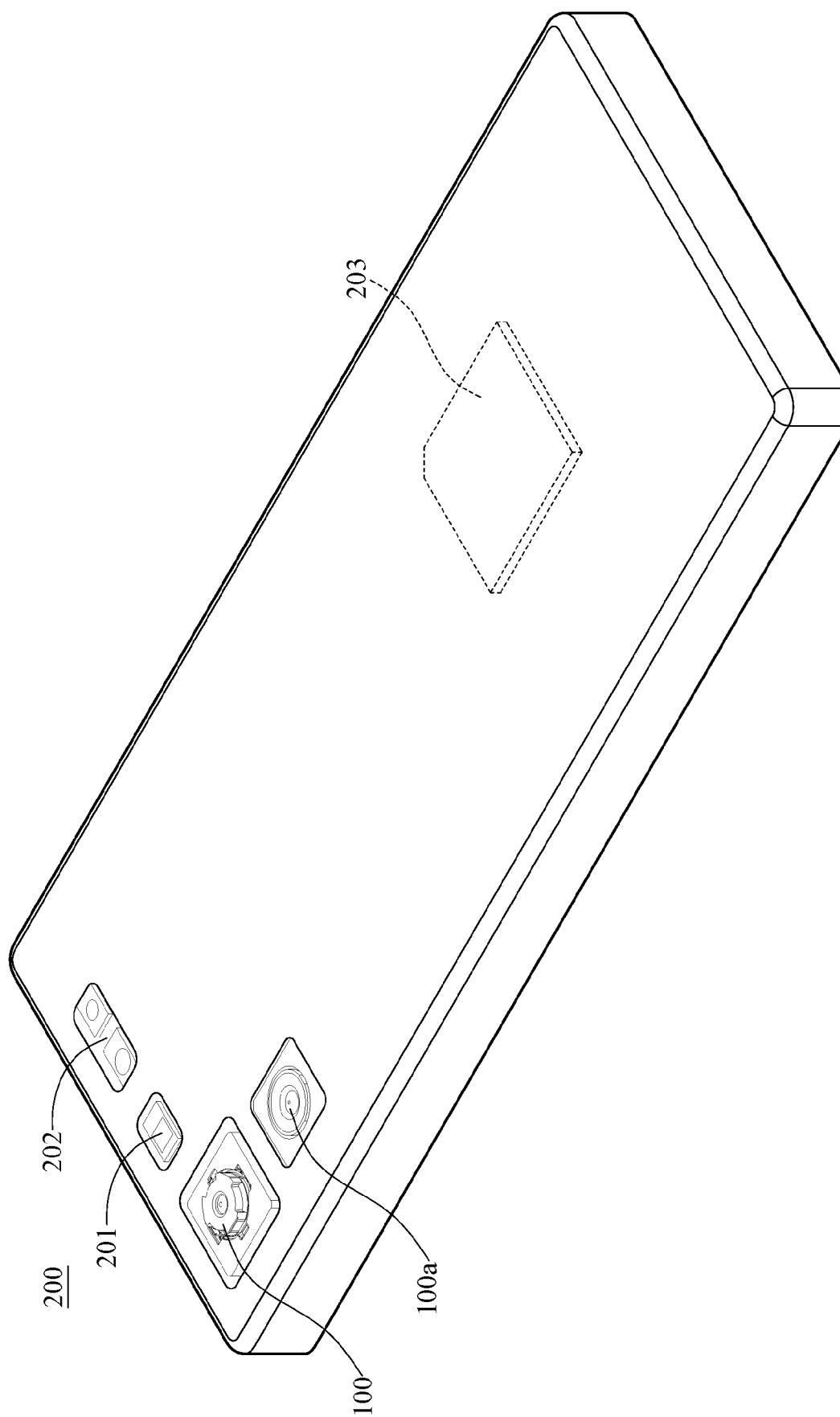
FIG. 18
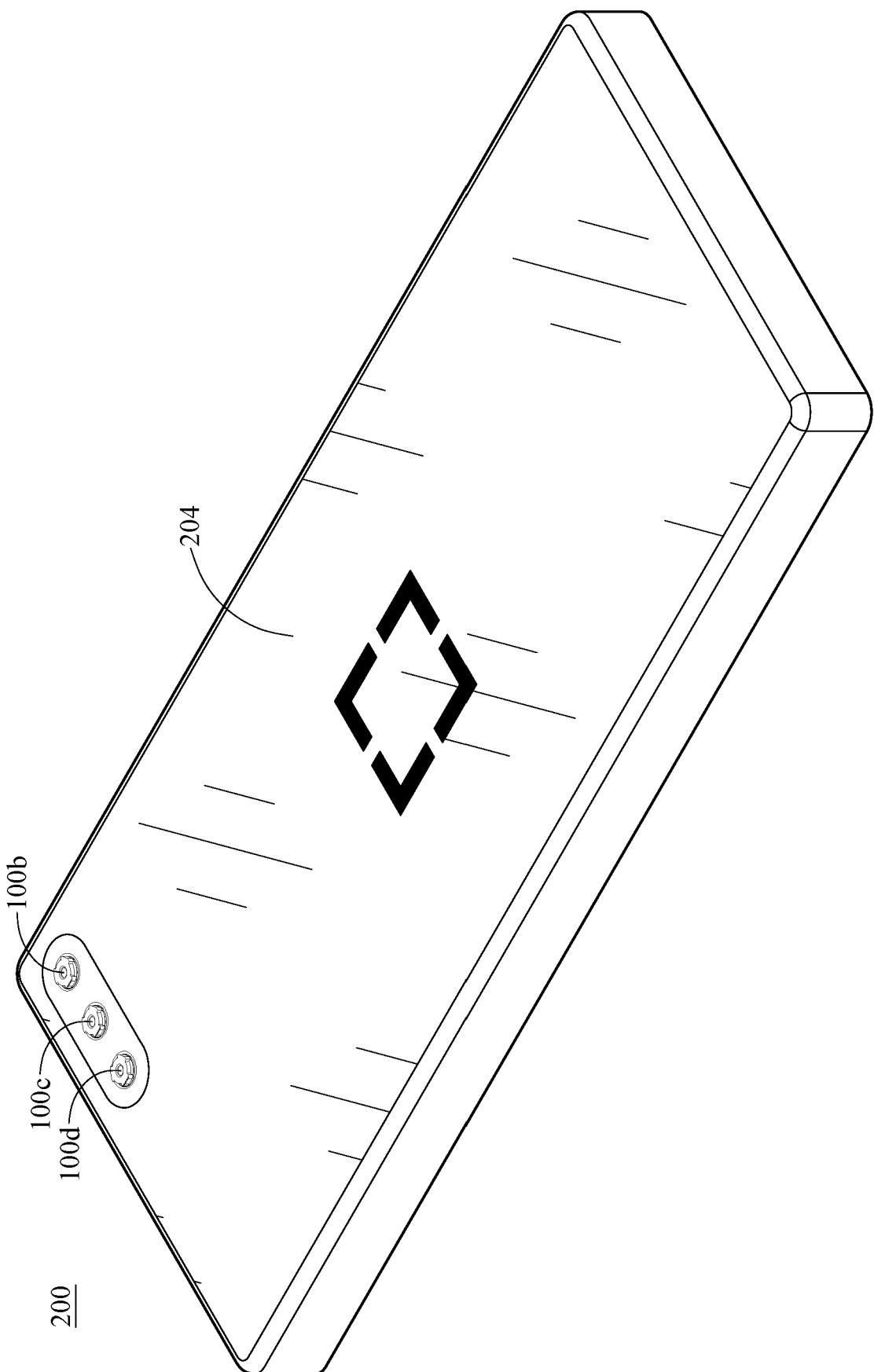
FIG. 19
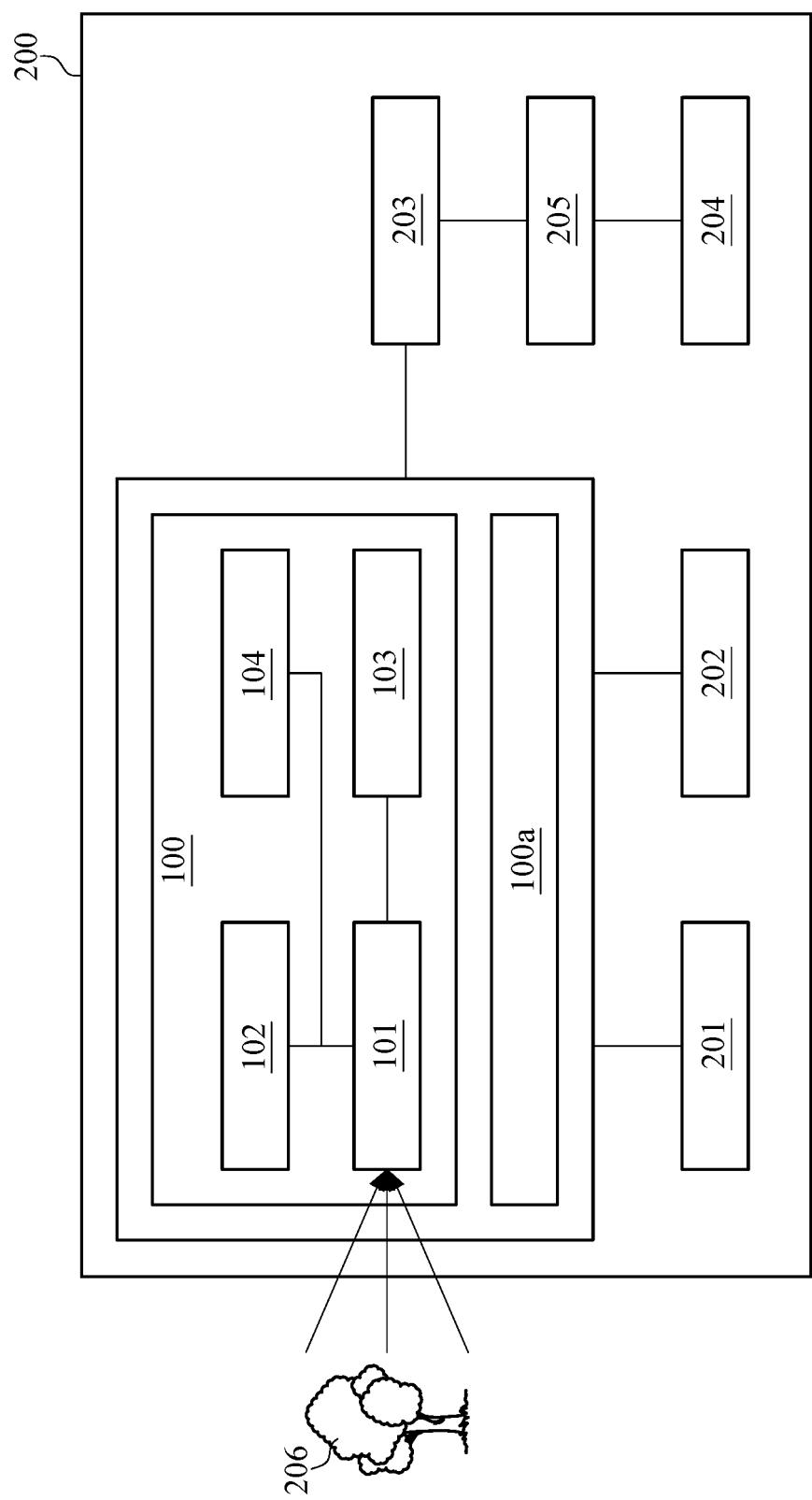
FIG. 20
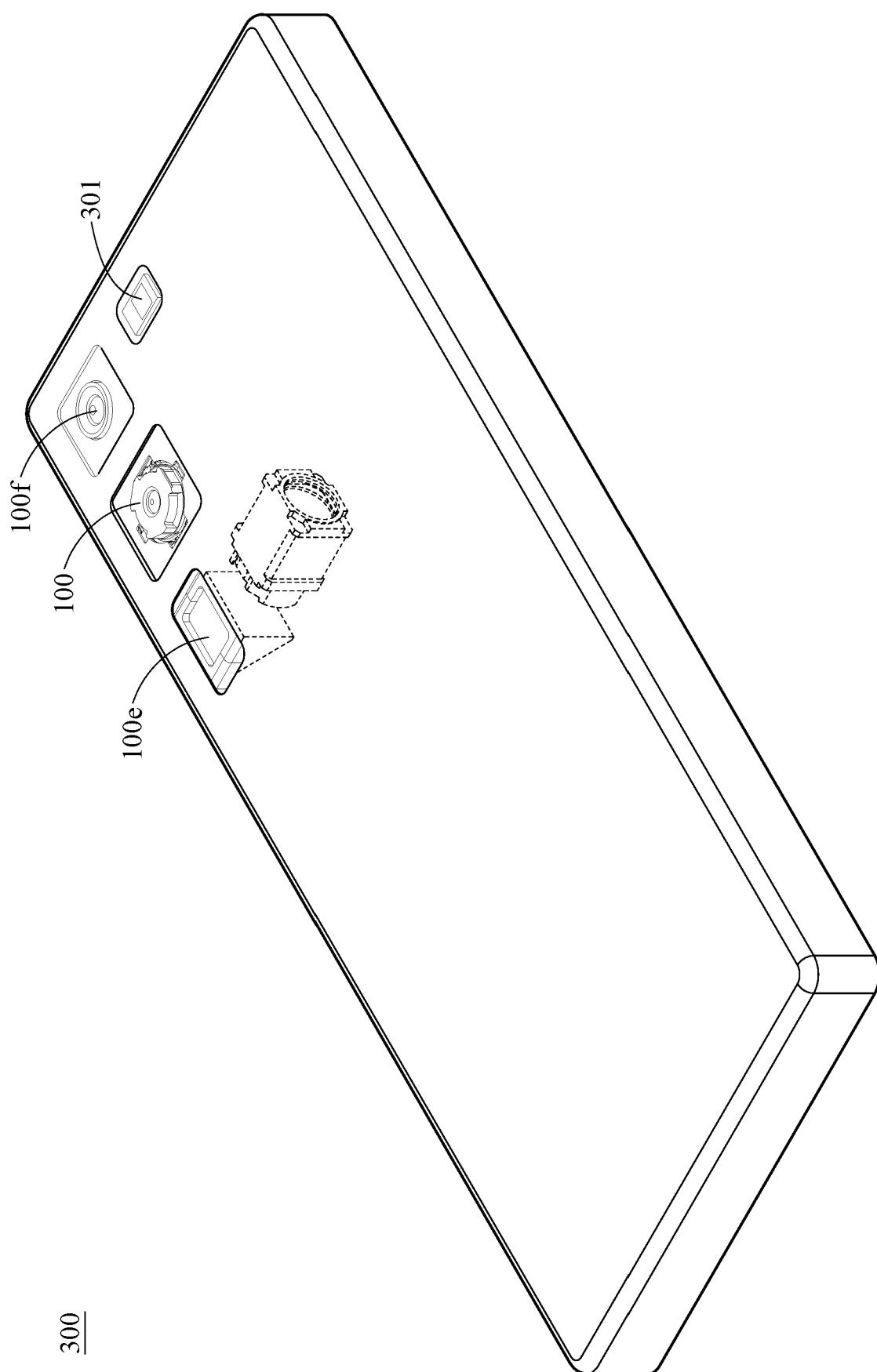
FIG. 21
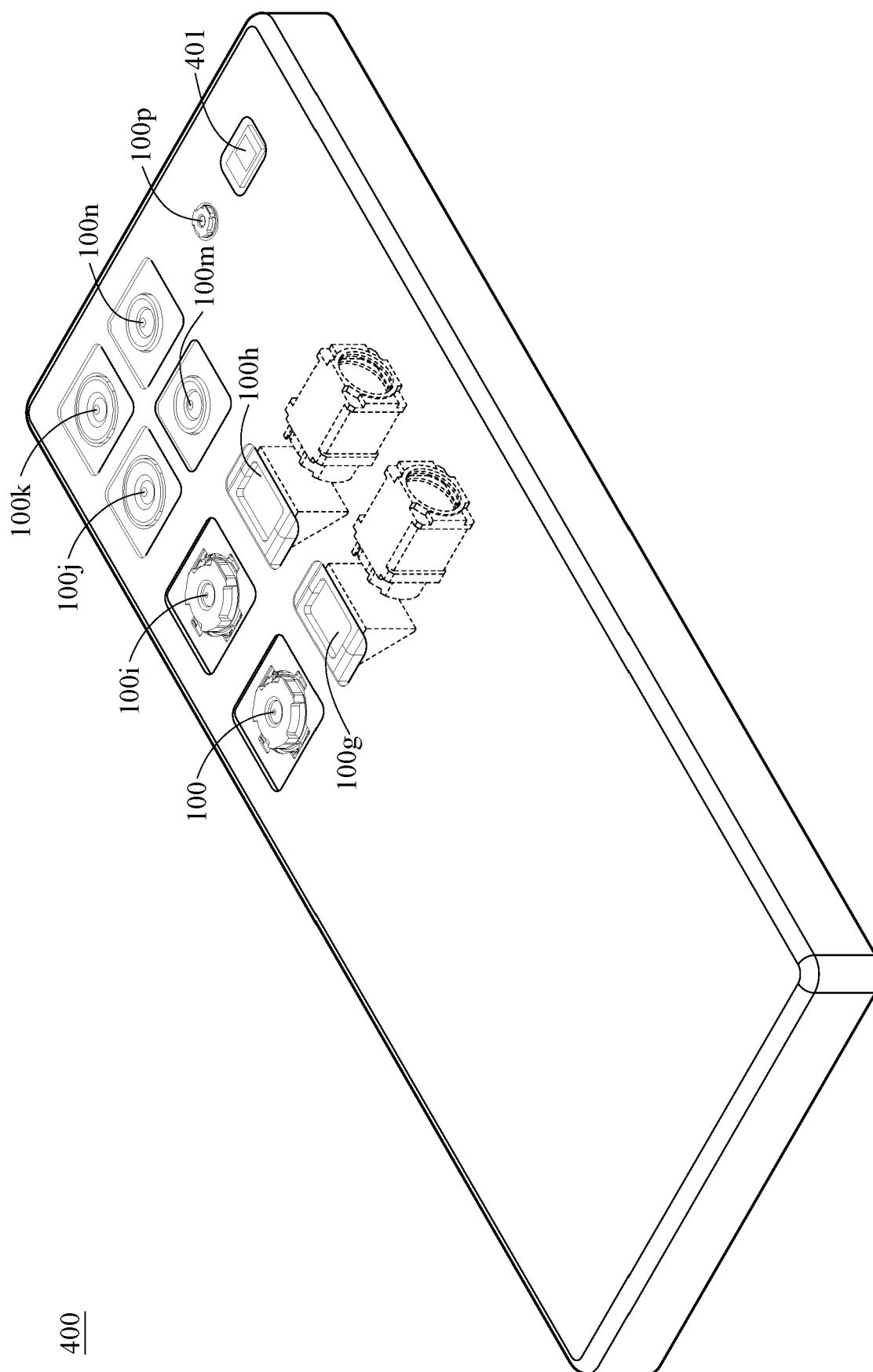
FIG. 22
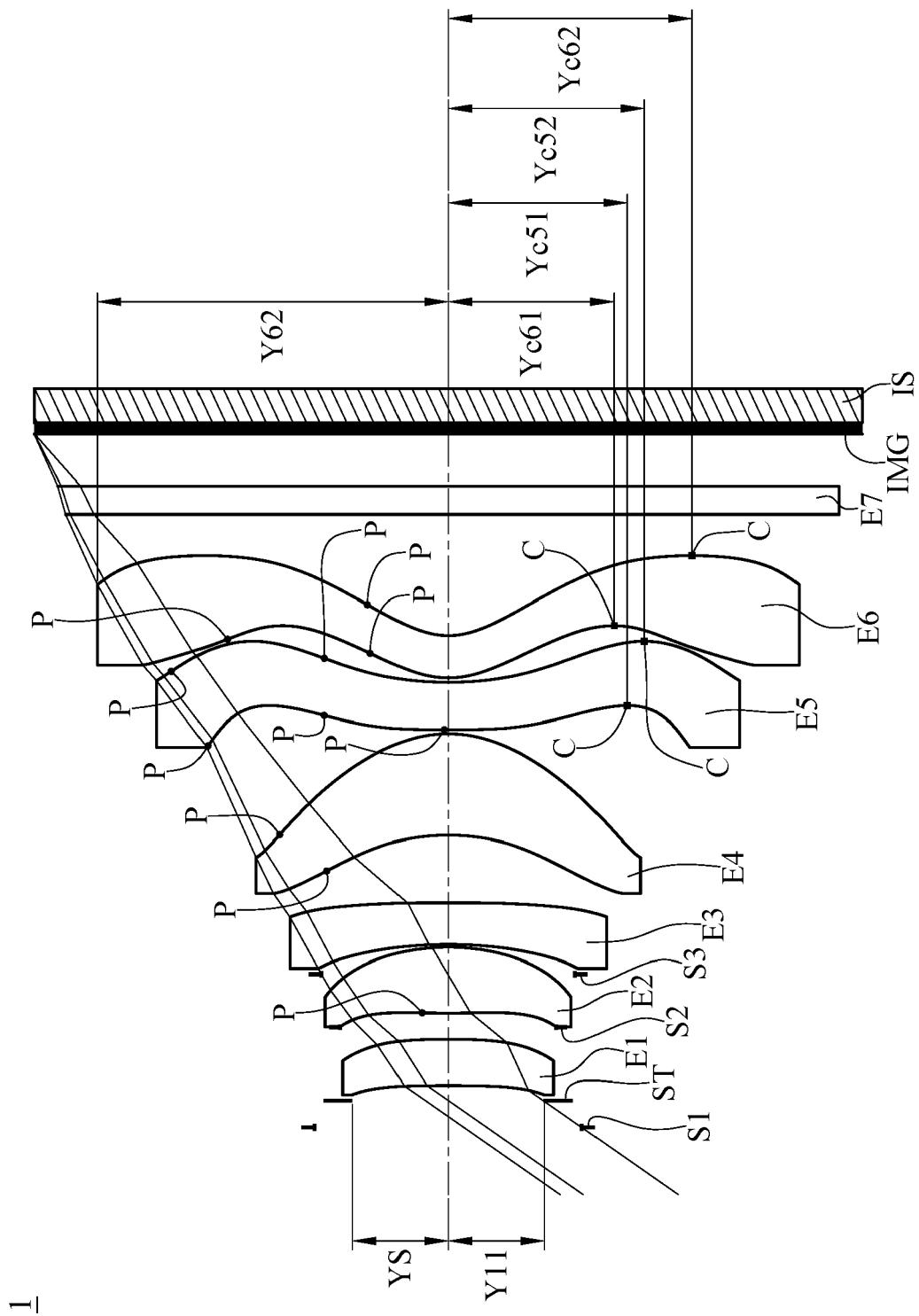
FIG. 23

FIG. 24

FIG. 25

FIG. 26

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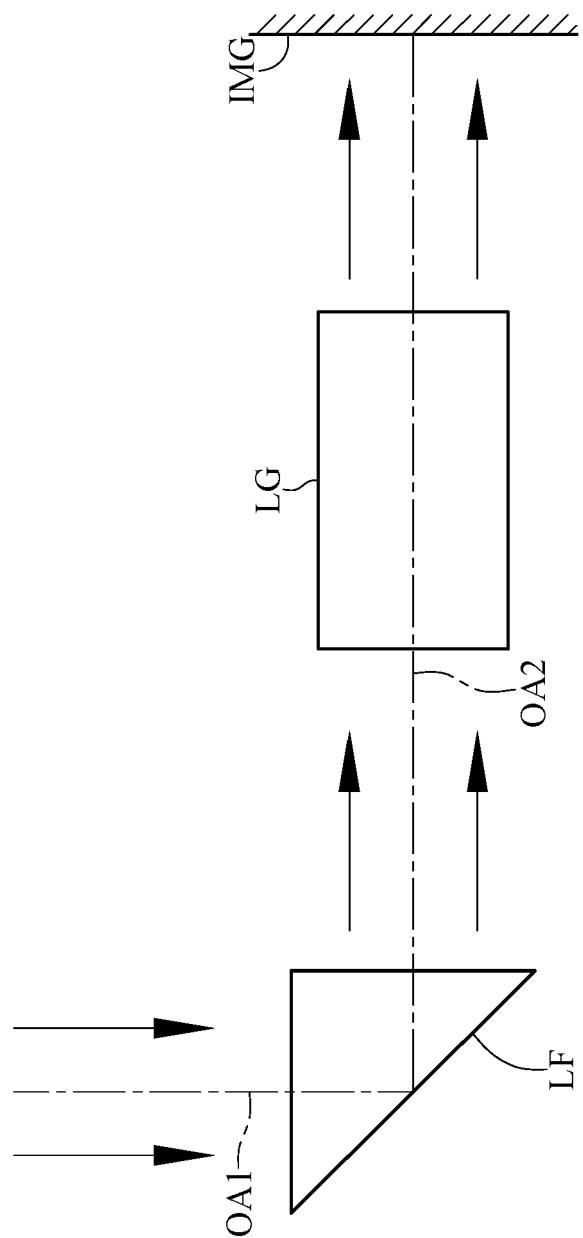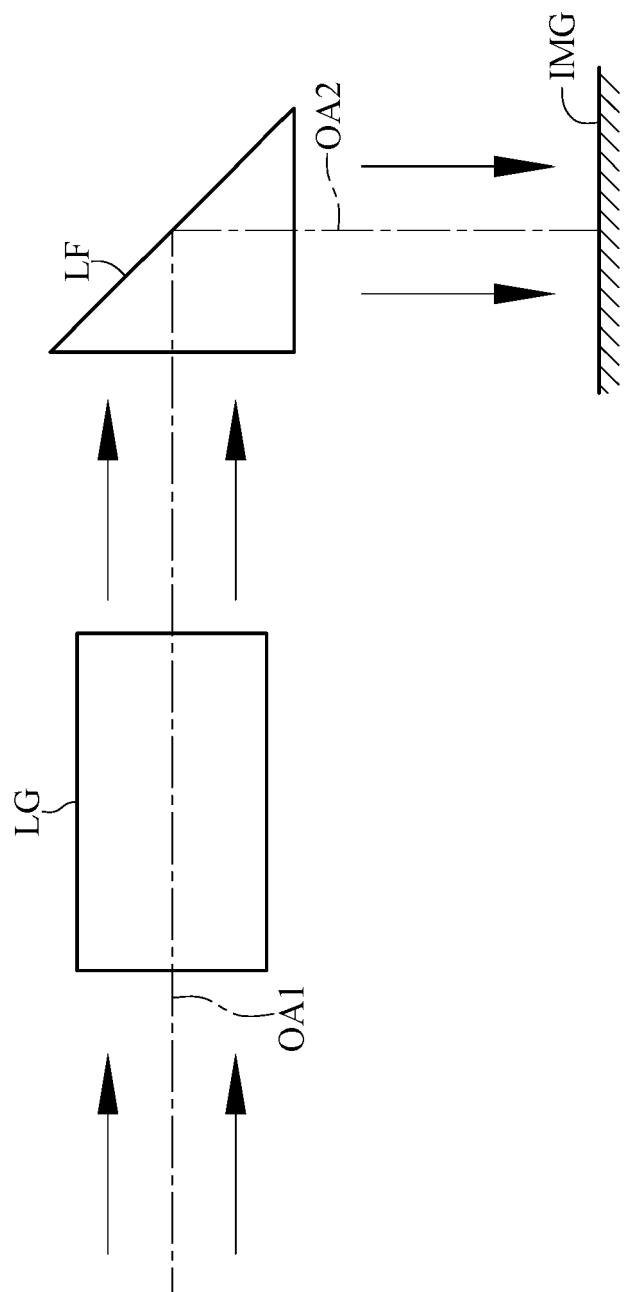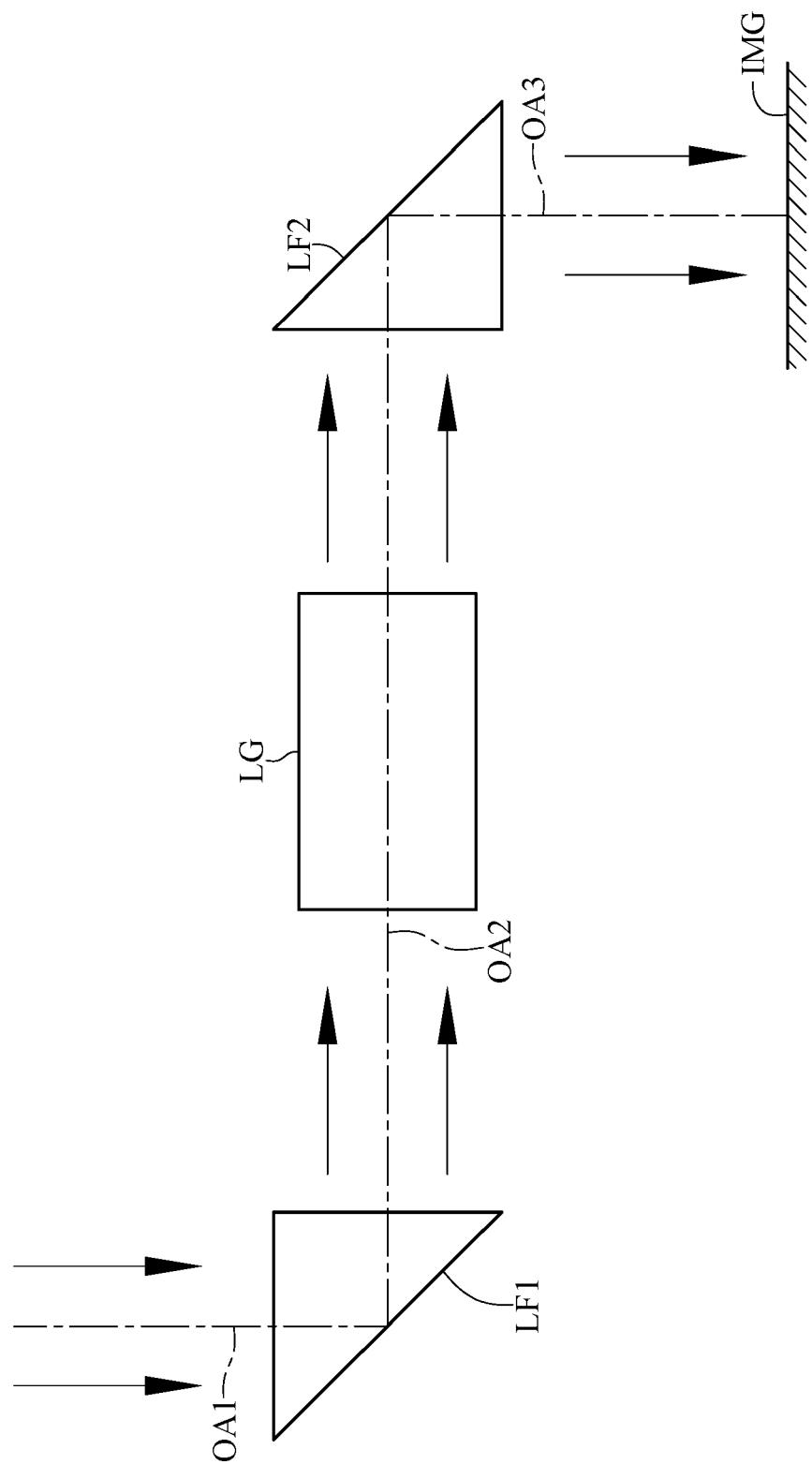
EUROPEAN SEARCH REPORT

Application Number

EP 22 15 6502

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2019/335121 A1 (FANG CHUNHUAN [CN] ET AL) 31 October 2019 (2019-10-31) * paragraphs [0052], [0111]; figure 1; example 1; table 1 *	1-9	INV. G02B13/06
A	US 2020/209568 A1 (TERANISHI TAKAAKI [CN] ET AL) 2 July 2020 (2020-07-02) * figure 1; tables 1,3 *	1-9	
A	US 2020/057263 A1 (KENJI OINUMA [CN] ET AL) 20 February 2020 (2020-02-20) * paragraph [0053]; figure 1; table 1 *	1-9	

TECHNICAL FIELDS
SEARCHED   (IPC)

G02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 July 2022	Michel, Alain

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another
    document of the same category
A : technological background
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or
    after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding
    document

EPO FORM 1503 03.82 (P04C01)

Application Number

EP 22 15 6502

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

  see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

  1-9

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-9

   Claim 1 relates to a six-lens imaging objective comprising a fourth lens being negative and a sixth lens being positive. Claims 2-9 depend on claim 1.
   The underlying problem to be solved is how to reduce the size of the image-capturing system in the optical axis direction (see the originally-filed description e.g. page 9 lines 14-19).
   The special feature is the inequalities $-7 < R4/CT2 < -1.6$, where R4 denotes the curvature radius of the image-side surface of the second lens and CT2 denotes the centre thickness of the second lens, that are fulfilled.
   ---

2. claims: 10-19

   Independent claim 10 relates to a six-lens imaging comprising a second lens being positive and a fourth lens being positive. Claims 11-19 depend on claim 10.
   The underlying problem to be solved is how to enlarge the field-of-view and correct geometrical aberrations (see the originally-filed description e.g. page 9 lines 20-27).
   The special feature is the inequality $?f/R1? + ?f/R2? < 1.5$ is fulfilled, where R1 denotes the curvature radius of the object-side surface, and R2 of the image-side surface, of the first lens.
   ---

3. claims: 20-27

   Independent claim 20 relates to a six-lens imaging comprising a second lens being positive and a fourth lens being positive. Claims 21-27 depend on claim 20.
   The underlying problem to be solved is how to reduce the outer diameter of the object-side of the image capturing system (see the originally-filed description e.g. page 9 lines 28-32).
   The special feature is the inequality $?f/R1? < 0.9$ is fulfilled, where R1 denotes the curvature radius of the object-side surface of the first lens.

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 22 15 6502

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82